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A COST AND SYSTEMS EFFECTIVENESS ANALYSIS OF CONSOLIDATED FIELD FEEDING FOR ARMY AIM DIVISIONS

October 1976

UNITED STATES ARMY
NATICK RESEARCH and DEVELOPMENT COMMAND
NATICK, MASSACHUSETTS 01760

Operations Research/Systems Analysis Office

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A cost and systems effectiveness analysis was performed to determine the overall impact of a consolidated field feeding concept as compared to the conventional company level system. Four alternative consolidated systems, which differed primarily on the basis of equipment and shelters provided, were evaluated. All four alternative systems showed a substantial savings in both food service personnel (ranging from 2396 to 2958) and KP personnel (ranging from 794 to 2162) for the 13 Army AIM Divisions. (cont'd)

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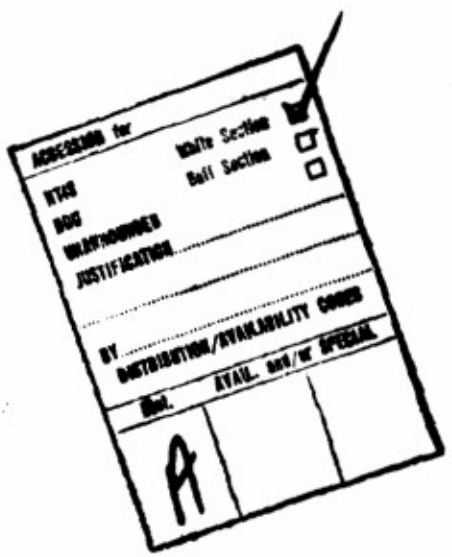
20. Abstract (cont'd)

The preferred alternative system consisted of a mix of Mobile Kitchen Trailers and XM-75 kitchens. All kitchens in this system were provided with improved sanitation equipment. The relative worth for this alternative showed a 123% improvement as compared to the baseline system of company level kitchens.



PREFACE

This report documents the results of a cost and systems effectiveness analysis of four alternative consolidated field feeding systems for the Army as compared to the standard company level feeding system. The major objective was to design and evaluate alternative systems of feeding troops in the field that would require significantly less food service personnel and which could be implemented quickly without significant follow-on R&D and testing activities. The major thrust in the system design effort was to emphasize the use of existing resources (i.e., shelters, equipment, food, etc.) to the maximum extent possible to achieve maximum reductions in the number of food service personnel without compromising the overall system effectiveness. Because of this thrust, the alternative systems emphasize the use of existing equipment supplemented by new equipment designed to achieve a maximum reduction of food service personnel within the Armor, Infantry and Mechanized (AIM) Divisions.

This analysis represents the completion of Phase I of the Army portion of the Joint Service Requirement AM3--1 under the DoD Food RDT&Eng Program, Project No. 1Y762724AH99A. Data used in this analysis were obtained from major experiments conducted in FY 76 at Camp Edwards, MA and Camp Pendleton, CA as well as other data collected during other field exercises.

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EXECUTIVE REPORT

Introduction

In 1974 a systems analysis was undertaken with the prime objective of achieving significant reductions in the number of personnel required to operate Army and Marine Corps field feeding systems. A two phase approach was undertaken, whereby Phase I would result in "quick-fix" recommendations to each service for short-term improvements which could be adopted without eny major R&D effort and implemented within a twelve month timeframe. Phase II is intended to provide e totally new state-of-the-ert concept which would be aveilable for impiementation in the 1985—1990 timefreme. The Phase II system would most likely requlre substantiel R&D effort as well as extensive testing.

During the Phase I effort a systems analysis was performed for the Army which showed the potentiel for significant personnel savings through consolidation of its field feeding system. At the present time, the Army Training and Doctrine Commend (TRADOC) is considering such e plen of consolidation.[1] The implementation of this plan would create an Army requirement to operate battalion leval field kitchens. This new requirement would, therefore, result in a common problem for the Army and Marine Corps, namely; how to efficiently provide hot meals to 800—900 troops from e single kitchen in a tactical envlronment. Since the analysis of Marina Corps field feeding (the Marine Corps already operates e battalion-leval system) had already uncovered a number of equipment problems which requlred immediate attention, work was initiated on the design of two new "quick-flx" systems for battalion level feeding. The first, designated the XM—75, was based on the use of an expandable frama type soft shalter with several new labor saving devices including new sanitation equipment. The second, designated the XM—76, was based on the use of three Mobile Kitchen Treilers centrally connected by a sectional platform to operate as e homogeneous facility. In order to gain operational data two field feeding experiments were conducted; one during August 1975 with Army Natlonel Guardsmen et Camp Edwards, MA, end e second during March 1976 with Marine Corps units at Camp Pendleton, CA. The primary purpose of these experiments was to eveluate the relative performance of the exlsting systems end the two new systems, and to verlfy the projected personnel savings which could be achieved with the new systems.

[1] "Unit Dining Facilities" Final Report No. ACN22896, US Army Quartermaster School, Fort Lee, VA, April 1976.

The data gained from these experiments,[2,3] as well as previously available information and data, provided the basis for the cost and systems effectiveness analysis documented herein. This report then provides the Army with the information necessary to make major decisions regarding the consolidation concept and associated systems which can result in significant reductions in combat food service personnel requirements within the next 12–18 months. The analysis was based upon current Army Division organizations.

Objectives

The objectives of this analysis were to:

1. Determine the impact of four alternative field feeding systems on personnel savings for all Armor, Infantry, and Mechanized Divisions in the active Army.

2. Assess the critical problems inherent in any consolidation plan.

3. Establish cost data which represent an accurate assessment of equipment and operational costs associated with four alternative field feeding systems.

4. Develop a systems effectiveness model to evaluate the ability of each alternative to perform the intended mission.

5. Use the cost and systems effectiveness data to develop a set of quantitative relationships which can be used as a basis for comparison between the alternatives.

6. Determine the compatability of a consolidated field feeding system with an existing Army garrison system.

7. Analyze the quantitative relationships among the alternative systems to formulate conclusions and make timely recommendations to the Army which will aid in the decision making process.

[2] Baritz, S., et. al., "The Camp Edwards Experiment in Battalion Level Consolidated Field Feeding", Technical Report No. 76–45–OR/SA, US Army Natick Research and Development Command, Natick, MA 01760, December 1975.

[3] Baritz, S., et. al., "The Camp Pendleton Experiment in Battalion Level Field Feeding", Technical Report No. 7T–4–OR/SA, US Army Natick Research and Development Command, Natick, MA 01760, July 1976.

Description of Alternatives

The cost and systems effectivaness analysis detailed in this report was besed upon a comparativa evaluation of four alternative systems. Each of these systems would allow the Army to implement the proposed consolidetion plan. The existing company ievel concept equipped with tha M–1948 kitchen was employed as the baseline. It is important to note that the basic difference in these elternatives concerns the mix of equipment utilized, as well as whether or not electrically powered equipment is available. A summary of the four alternatives is shown in Table I and e deteiled description of the equipment which comprise tha alternative systems, including interior leyouts and exterior photogrephs, is contained in Appendix A.

Alternative I. This alternative assumes the usa of the Mobile Kitchen Trailer for small kitchens serving 250 troops or less. For the intermediate (251–500 troops) and large size (over 500 troops) kitchens, conventionel M–59 renge cabinets with burner units housed in General Purpose (GP) Medium Shelters ere assumed. The primary difference between the intermediate and large kitchens for Alternative I is that the intermediete kitchan will require only two shelters (one for food preparation and serving end a second for sanitation and dry goods storage) while the large kitchen requires three (the third sheltar housing tha serving lines). Also, there are edditional quantities of standard equipment provided with the large kitchen. Standard sanitation equipment, i.e., immersion heaters with GI cans, is employed by ell kitchens including the Mobile Kitchen Trailer.

Alternative II. This approach is tha same as Alternative I for the smell and large kitchens; however, the intermediate size kitchen, feeding 251 to 500 troops, consists of two MKT's. Sanitation is still performed by means of Immersion heaters and GI cans.

Alternative III. This alternative assumes e Mobile Kitchen Trailer for the small kitchen. However, the sanitation equipment is new and consists of field sinks end storage racks housed in a small frame typa shelter. The intermediate (XM–75A) and large (XM–75) size kitchens for this alternativa utilize tha new moduler XM–75 system housed in en expandabla frame type shaltar and equipped with some electricelly powered labor saving equipment, a hot water heater, and new sanitation equipment. The only difference between the intermediate and large kitchen is the length of tha shalter plus the quantity of equipment provided.

Alternative IV. This epproach is tha same as Alternative III, axcept that the intermediate size kitchen is predicated on the use of two Mobile Kitchen Trailers. The sanitation equipment has been upgraded and is the same es that provided with Alternativa III.

TABLE I

Summary of Alternative Systems

Alternative	System Capacity Small (250 and Less)	Intermediate (251 to 500)	Large (Greater Than 500)
I[a]	MKT (Std)	2-GP Medium Tents With M–59 Ranges, Standard Sanitation Equipment	3-GP Medium Tents With M–59 Ranges; Standard Sanitation Equipment
II[a]	MKT (Std)	2 MKT's (Std)	3–GP Medium Tents With M–59 Ranges
III[b]	MKT (Modified)	XM–75A	XM–75
IV[b]	MKT (Modified)	2 MKT's (Modified)	XM–75

[a]Alternatives I and II have all standard equipment for food preparation and sanitation.

[b]Alternatives III and IV have a mix of standard equipment and new nonstandard equipment designed to reduce labor and improve sanitation quality. The XM–75 is housed in an expandable frame type shelter and includes new griddles, steam tables, electrically powered equipment and a oil fired hot water heater. The XM–75A is a scaled down version of the XM–75.

It should be noted thet more sophisticated field kitchens have been undergoing development and testing by NARADCOM during the past 5 years. These kitchens ere equipped which such state-of-the-art devices as microwave ovens, liquid fuel fired convection ovens and steam cookers. However, these kitchens were excluded from consideretion in this anelysis since they did not meet the objectives of the Phase I effort which is oriented toward short term implementation. Nevertheless, these more sophisticated systems will be eveluated under the Phase II effort of this program which is expected to be completed by Januery 1978.

This report documents the results of e cost and systems effectiveness analysis which was performed based on the Army's 13 Armor, Infentry end Mechenized (AIM) Divisions using the data from the Camp Pendleton and Camp Edwerds experiments as well as previously available informetion and data. This analysis should assist the Army not only in making a decision regarding the implementation of a new concept for field feeding, but also in determining the preferred mix of equipment which will optimize the benefits derived from consolidation.

Results and Conclusions

This section of the executive report presents the results end conclusions thet were derived from the detailed analysis contained in the remaining chapters of this report.

1. The proposed TRADOC consolidation plen represents a unique opportunity to achieve major reductions in combat service support personnel. However, critical problems associated with the concept of a consolideted field feeding system, i.e., shelters, sanitation end remote site distribution must be resolved. Failure to solve these problems will seriously jeopardize successful implementation.

2. The mix of equipment issued in the consolideted system has e significent impact on total personnel savings. The Mobile Kitchen Treiler(s) end the GP medium shelters with standard equipment (Alternatives I end II) will reduce the number of food service personnel in the 13 AIM Divisions by 2395 (33%) while KP's will be reduced by 794 (15%). By comperison, the introduction of several items of new improved equipment (Alternatives III end IV) will reduce the food service personnel requirements for the 13 AIM Divisions by 2958 (40%) end KP savings by 2162 (40%). In eddition to providing additional savings of personnel, Alternatives III end IV will elso solve the serious shelter, sanitation end operationel problems inherent with consolidation.

3. Using the 2nd Armored Division (Ft. Hood, Texes) es en exemple, it is concluded that their existing garrison operations can continue to function with the reduced staffing of food service personnel which would result from any of the Alternative systems. However, the Division Food Service Office must have complete control over the assignments of personnel to garrison dining facilities.

4. Compared to the baseline company level kitchens, all of the alternative systems result in significant reductions in labor costs. Alternatives III and IV provide the greatest annual labor savings of $68.5 million ($44.5 million of this savings is attributed to food service peronnel, while $24.0 million is attributed to KP's). Alternatives I and II provide an estimated ennual lebor savings of $45.7 million ($36.9 million of this savings is ettributed to food service personnel, while $8.8 million is attributed to KP's).

5. Capital investment costs for implementing e consolidated system in the 13 AIM Divisions range from e low of $21.4 million for Alternative I to e high of $29.8 million for Alternative III.

6. On the basis of Cost end System Effectiveness, Alternetive III (MKT's for small and XM-75's for intermediate end large kitchens) is the preferred system with a 123% increase in relative worth compered to the baseline system. Alternative IV was next with 112% increase while Alternatives I end II provide increases of 21% and 26%, respectively, in relative worth.

7. The current Manpower Authorization Criterie (MACRIT) used for establishing TO&E's for Army food service personnel does not provide for adequete staffing of kitchens above the Compeny level when utilizing standard field equipment.

Recommendations

Based on the Phese I results of this system analysis of Army field feeding the following is recommended:

1. Plens be made to implement the TRADOC proposal for a consolidated field feeding system.

2. Organizational Implementation could commence immediately, however the authors strongly recommend that implementation coincide with the introduction of new shelters and new items of food preparation and sanitation equipment described in Appendix A. Sole use of existing equipment for battalion level kitchens will not only significantly reduce the achievable personnel reductions but also result in serious deficiencies and shortcomings.[4,5] This is particularly true of the GP medium tent (which neither provides adequate workspace nor ventilation) and existing sanitation equipment.

[4] McCombs, W. C., Major, US Army, et al., "Division Field Feeding Concept Evaluation", TCATA Test Report No. FM 335, Headquarters, TCATA, Fort Hood, Texas 76544, September 1976

[5] op. cit. 3

3. A decision on the use of MKT's at the 400–600 troop level should be made at an early date. Experience with the existing configuration has demonstrated serious human factors and workspace design problems when used above the company level which require additional design and evaluation to correct.[6]

4. The XM–75 system be evaluated for battalion size or higher level operations in rear areas where maximum mobility is not critical. Its low cost and high efficiency make it particularly attractive. Since this system will be adopted by the Marine Corps in FY 77, it could be implemented with minimum additional testing by the Army.

5. A project be initated to review and revise that portion of AR 570–2 (MACRIT) pertaining to food service personnel so that staffing is adequate for consolidated field kitchens.

6. Improved sanitation equipment be adopted for field use by all Army kitchens regardless of size. The MKT should be equipped with the same type shelter, sinks, and storage racks provided in tha XM–75. Operations above the company level should also be provided tha field water heater and electric pumps which will yield additional KP savings and improve quality of sanitation.

7. All operations above the company leval should be provided with or have access to electrical power. A 10 kw generator would provide more than sufficiant power for the electrically drivan equipment recommanded in this report.

8. Labor saving devices such as electric meat slicer, can opener, and vegetable cutter should be provided as standard equipmant with intermediate and large kitchens.

9. As a minimum, disposable mess geer should be provided for units eating away from the kitchen site. Tha cost of disposables should be included in tha Basic Deily Food Allowance so that Commanders will not hava to axpend their scarce O&MA dollers.

10. Current KP policy must be revised. Eithar an extanded tour of duty must be established or KP duty eliminated and performed by apprentica cooks permenently assigned to kitchens.

[6] op. cit. 3

11. The concept of the food service company[7] to support selected Divisional as well as Corps units be further investigated at an early date to achieve still further reductions of personnel.

12. Serving and distribution procedures specified in the consolidation plan for remote sites be tested as soon as possible. These procedures have not been adequately validated in any of the experiments conducted to date.

[7]Smith, R. S., et. al., "A System Evaluation of Consolidated Field Feeding for the Army", Technical Report No. 75--83 OR/SA, US Army Natick Research and Development Command, Natick, MA.

CHAPTER II

CRITICAL PROBLEMS INHERENT IN CONSOLIDATION

While consolidation of the Army's field feeding system offers very attractive savings in food service and KP personnel, the success of the new concept and realization of the maximum personnel savings potential will depend largely on the extent to which significant problem areas can be resolved. This should not be surprising, since any radical change in doctrine would be expected to offer some trade-offs. It is the intent of this chapter to identify those issues which the authors consider most important to assuring successful implementation of e consolidated field feeding concept, and to offer specific solutions based on the results of two field feeding experiments[8,9] and observations made during field training exercises. The problem areas which must be addressed if the Army is to achieve the full potential of consolidation are summarized in Table 2. It should be noted that these problems have been broken down into two categories -- critical and major. The critical issues are those which the authors consider absolutely essential to the successful implementation of the TRADOC plan for consolidation. By contrast, the major issues are those which will affect the overall efficiency and acceptance of the concept by the affected units.

TABLE 2

Consolidation Issues

Critical	Major
Shelters	Staffing Levels
Sanitation	Mobile Kitchen Trailers
Distribution to Remote Sites	Food Service Equipment
	Policy on KP's

The following is a discussion of the above issues together with proposed solutions derived from analysis of available options:

[8] op. cit. 2

[9] op. cit. 3

Shelters

Problem: The only kitchen shelter currently in the system is the M–48 company kitchen tent. The tent is very difficult to erect because of the high ridge-pole design; it can not be adequately secured for inclement weather operations; and it can only accommodate sufficient equipment to handle a maximum of 400 troops.

Another shelter which has been used by both the Army and Merine Corps to house field kitchens is the GP medium tent. However, this shelter is grossly inadequate. The ridge-pole design makes it difficult to erect and it does not stand up well to inclement weather. Insufficient access through the one small door at each end constitutes a safety hazard. There are no provisions for screened openings (windows) other than rolling up and screening the whole side. Ventilation is so inadequate when it is used as a kitchen shelter that head-level temperatures of 140°F and above have been recorded with ambient temperatures of 70–80°F, and the sides of the tent rolled up.[10]

Solution: If the large consolidated kitchen is to be housed by a shelter, replacement of the GP medium tent with the XM–75 expandable shelter would eliminate all known deficiencies. The XM–75 is a frame support, modular shelter, which can be tailored in the field to any size kitchen in 8-foot increments. This shelter basically consists of standard Army components, which have been modified to make the shelter more effective for kitchen operations.

As compared to existing kitchen shelters, the XM–75 offers greatly improved workspace design[11] by eliminating the center posts, improved access, lighting and foul weather protection, and vastly improved ventilation through the large screened openings in each roof panel. Prototypes have undergone sufficient field testing to be acceptable for procurement by the Marine Corps in FY 77. Also a prototype will be tested by the Army Medical Corps in FY 77 to determine if it meets their requirements for hospital field feeding.

[10] op. cit. 3

[11] op. cit. 3

Sanitation

Problem: Sanitation is e two-fold problem of (1) washing pots, pans and other kitchen utensils, and (2) washing of individual mess gear. Only the former will be discussed here. The latter will be covered under the problem of Distribution to Remote Sites. The currently available kitchen sanitation system consists of 32-gal cans and immersion heaters. At battalion level, approximately 10 Gi cons are used for this task which requires employment of 8 KP's. The workload consumes nearly as many productive man-hours of effort as food preparation itself. The system is grossly inadequate since hot water temperature cannot be maintained at required levels and large pots and pans cannot be immersed for proper sanitation. Consequently, water must be dipped from the GI can and poured over the item being washed. This result of the low water temperature is very poor quality sanitation which constitutes e potentially serious health hazard.[12] Furthermore, the present system requires continuous replenishment of water in the cans, which compounds the problem of maintaining proper temperatures for adequate sanitation. Another problem concerns the frequent lack of any shelter for housing the pot and pan washing operation which makes foul weather operation even more ineffective. Additionally, there are no provisions for the storage of cleaned items, except for whatever salvaged dunnage or home-made racks the unit is able to provide. These sanitation deficiencies are applicable to field kitchens of all sizes end equipment configuration including the Mobile Kitchen Trailer.

Solution: The XM–75 sanitation concept described in Appendix A will eliminate the sanitation problems of the existing system. Not only will it result in e dramatic improvement in the quality of sanitation, but it will also significantly reduce manpower requirements, as well as provide a reasonable working environment under hot climatic conditions.

Distribution to Remote Sites

Problem: The distribution plan is predicated on the assumption that company-size (250 troops) and smaller units supported by a consolidated field kitchen have sufficient organic resources to effect pick-up of prepared, bulk-packaged meals at a designated staging area, delivery and distribution to the consumers. Also included in the distribution concept is the requirement for consuming units to return their empty insulated food containers back to the staging area. The use of nondisposable mess gear along with the transport, maintenance and operation of the required sanitation equipment, would impose an unacceptable burden on these units under this system. Comparison of the resources required to distribute one meal to a company size unit using mess kits vs. disposables

[12] op. cit. 3

is depicted in Figure 1. It should be noted that in addition to greatly reducing the transportation requirement, the use of disposables reduces the time and labor expenditure by 67% as compared to that required with mess kits.

Solution: The requirement for sanitizing individual mess gear at remote feeding sites should be eliminated through the use of disposables (e.g., GSA Number 7350–01–012–8787). To reduce disposable consumption, non-disposable gear (preferably compartmental trays) should only be used when food is served at the kitchen site. These trays should be maintained and cleaned by the field kitchen. The capability of specific units to handle their own delivery and distribution can only be determined through field testing in a realistic scenario. The assessment of this capability was one of the test objectives in the FDTE[13] recently conducted by the TRADOC Combined Arms Test Activity at Fort Hood, Texas. However, test conditions precluded a complete evaluation of the distribution concept.

Staffing Levels

Problem: The overall mission effectiveness of a field feeding system depends on the capabilities and limitations of its key components, i.e., personnel and equipment. The efficiency of this man/material relationship can be expressed in terms of system productivity, that is the number of meals produced per man-hour of effort. Any significant equipment shortfalls, such as those discussed in this chapter, will result in reduced productivity, which is usually compensated for by allocation of additional manpower. Since the main objective of consolidation is to achieve maximum personnel savings, the existence of major equipment shortfalls is obviously unacceptable, as it will have a significant impact on the staffing requirements for a given system. Table 3 demonstrates the penalty to be paid in terms of additional personnel in a typical AIM Division for failure to correct any of the equipment shortfalls identified (see Chapter III for detail analysis).

TABLE 3

Personnel Summary for One AIM Division

System	No. Required		% Savings	
	Fd Serv Personnel	K.P.'s	Fd Serv Personnel	K.P.'s
Current Co. Level	566	412	–	–
Consolidation (Alternative I and II)	382	351	33%	15%
Consolidation & New Equipment (Alternative III and IV)	338	245	40%	40%

[13]Op. cit. 4

THE BURDEN ON THE COMPANY

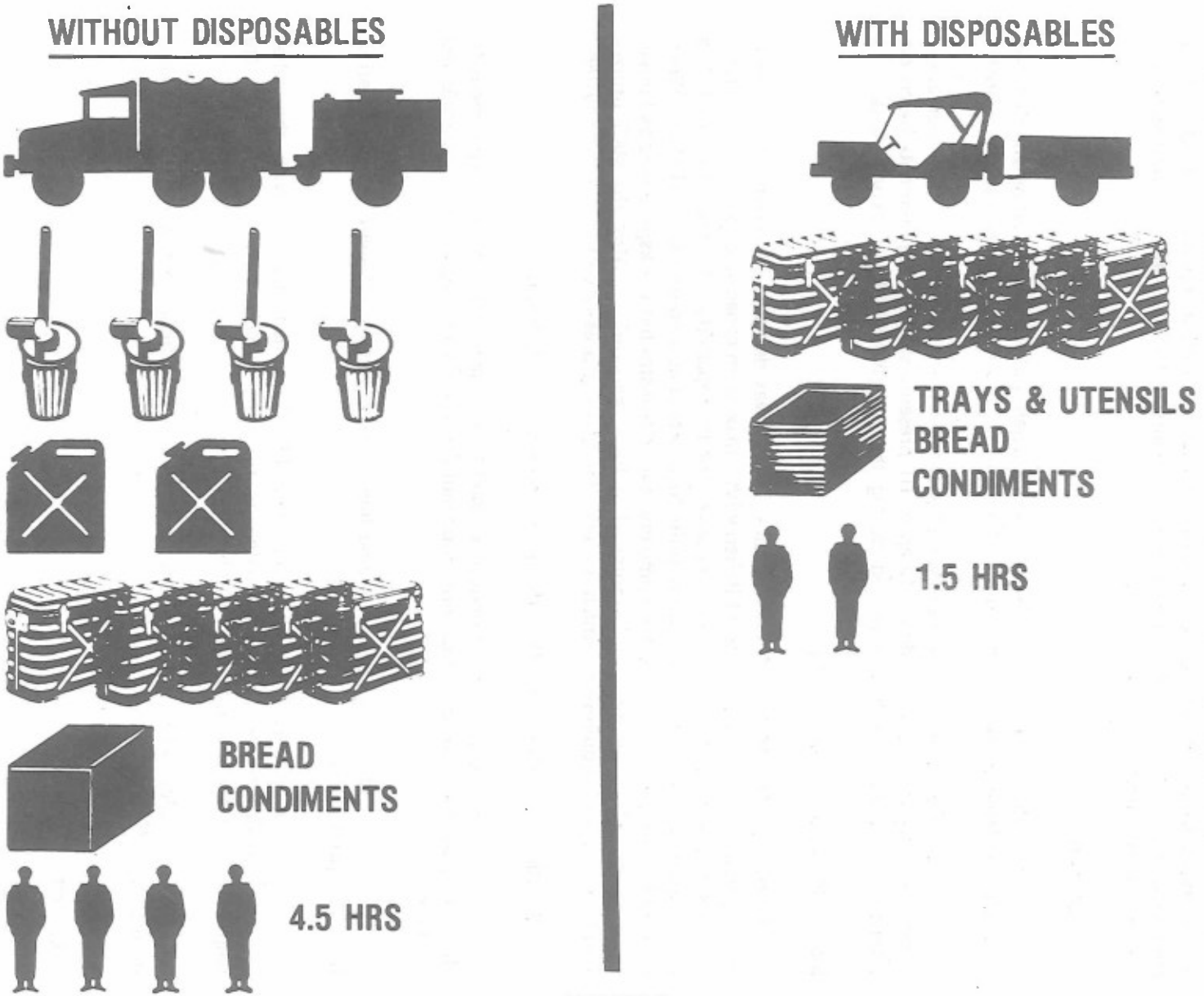


FIGURE 1

Food Distribution Requirements

The Camp Pendleton experiment also showed that the current manpower authorization of 14 cooks from AR 570–2 was 4 short of that required to operate a standard field kitchen at the 900-man level. This indicates a significant discrepancy in the manpower authorization criteria used in AR 570–2.

Solution:

a. Provide the most efficient field kitchen and sanitation equipment that can be made available in the short term without major research and development effort.

b. Revise existing manpower allocation criteria which are too conservative, based on analysis of current data. Chapter III presents staffing requirements based on extensive work-sampling data collected during the two NARADCOM experiments.[14]

Mobile Kitchen Trailer (MKT)

Problem: The Mobile Kitchen Trailer (MKT) was designed to provide a compact, mobile, standardized company field kitchen with a maximum capacity of 300 troops. Space and design constraints preclude any expansion of its capability. Further, the MKT was not designed for coupling two or more units to function as a consolidated kitchen. When utilized in multiple units above the company level the restricted workspace creates human factors problems[15] for personnel employed in food preparation. Also, the MKT utilizes standard sanitation equipment, which is one of the major problems with the current system.

Solution: Modify the MKT design to provide the following:

a. A quick mount/dismount capability for each major item of equipment to allow for rearrangement of equipment when multiple MKT's are employed for consolidated kitchens.

b. A sheltered outside serving line to permit more efficient space utilization for food preparation.

c. A means of multiplexing two MKT's, which together with the other proposed modifications would eliminate the problems which occur when MKT's are employed as a consolidated field kitchen.

d. More efficient and effective sanitation equipment similar to that available in the XM–75.

[14] op. cit. 2 and 3

[15] op. cit. 3

Food Service Equipment

Problem: Equipment efficiency impacts on staffing requirements, production capacity, system responsiveness, food quality, cost – in fact it is one of the key elements of the system's effectiveness. Shelters and sanitation equipment have already been covered under separate headings. This paragraph addresses the following remaining equipment shortfalls:

a. Griddles: The use of squarehead lids in the M–59 range cabinet as griddles is inefficient. Placed on top of the range cabinet it is too high for the average cook; capacity is very limited; there are no provisions for excess grease to run off; heat transfer characteristics are poor; and it precludes other use of the range cabinet. Therefore, it is common practice for units to construct their own griddles, nicknamed "Iron mikes" from various materials such as heavy gauge aluminum, steel, or armor plate.

b. Labor-Saving Devices: At company level the use of powered labor-saving devices would not produce sufficient workload reduction to justify the added cost of a dedicated generator. However, at the higher consolidated levels, the use of powered equipment for certain tasks such as meat slicing, vegetable cutting, can opening and transferring hot water used for sanitation would result in significant additional personnel savings. Table 4 compares the labor requirements of manual vs. electrically powered functions for one meal at the 900 customer level.

TABLE 4

Labor Saving Potential with Powered Food Service Equipment

Task	Man-Hours Required	
	Manual	Electric Powered Equipment
Slice Roast Beef	8.0	1.5
Prepare Tossed Green Salad	6.5	4.5
Open 300 Cans (1 B-Rat. Dinner)	2.0	1.0
Pot and Pan Sanitation (1 Meal)	29.6	15.7

c. Work Tables: Adequate work tables which are durable, easily transportable, and easy to maintain in a sanitary condition are essential to effective food preparation. Currently available work tables range from wooden crates, to field tables of various types and sizes, to garrison-type dining tables. Wooden tables are generally unsuitable for field kitchen use, and are seldom available in sufficient quantity, or proper size.

Solution:

a. Adopt a standard griddle, such as the one used with the MKT or XM–75 systems, which can be used in both a ground-mounted role and on kitchen trailers.

b. Adopt collapsible stainless steel work tables such as those used with the XM–75 system.

c. Provide consolidated field kitchens with generator power and the labor saving devices such as meat slicer, vegetable cutter, can opener, and water heater with pump.

Policy on KP's

Problem: Obtaining, transporting, training, supervising and motivating KP's are formidable challenges. With company-level field kitchen operations it is a manageable problem. Under the consolidation plan, however, the KP's for the larger field kitchens will be coming from a number of widely dispersed units. The current practice of daily rotation of up to 20 KP's for a single kitchen is a potential nightmare for the supervisor as well as the units in an operational environment. Additionally, the commitment of essential manpower to KP duties degrades the mission effectiveness of the units involved.

Solution: Without taking a totally new approach to field feeding, there doesn't appear to be a complete solution to this problem. There are, however, two possible courses of action which offer at least partial relief for battalion level kitchens:

1. The first option is to reinvest approximately 60% of the cook savings generated through consolidation in the form of apprentice cooks who would perform the necessary low skill functions. This would preclude the manpower drain on the operational units by making the kitchens self-sufficient. Eliminating the constant rotation and retraining would also increase KP productivity to the extent that the job could be done with a 25% reduction in personnel performing KP type duties. This course of action is consistent with the general move towards relieving the company-size units of all non-essential administrative and logistical burdens.

2. The second option is to extend the KP's tour of duty. This course of action would greatly alleviate the logistics involved in the daily KP replacement, and would reduce significantly the problems of training, supervision and low productivity. The Marine Corps, for example, has a policy of 30 day assignments for KP's. This policy is much more efficient and less burdensome than the daily rotation method. The major disadvantage of this approach is that it takes the soldier away from his primary duties for an extended period of time. On the other hand, he may not have to do it again for many months.

Conclusion

The proposed consolidation presents the Army with a unique opportunity to achieve a quantum improvement in their field feeding system at minimal cost. Failure to take positive action to resolve the problems discussed in this chapter will not only compromise the Army's ability to achieve still further significant personnel reductions in a vital combat service support function, but also will jeopardize the potential for successful implementation of the consolidated field feeding system.

CHAPTER III

STAFFING REQUIREMENTS

The total staff, food service end KP's, required to operate e field feeding system is dependent on the number of people to be fed, the meal discipline (type end quantity meals provided deily), design of workspace end the type and emount of food service equipment provided. This chepter is intended to identify the food service and KP labor requirements for the 13 active Armored, Mechanized Infentry, and Infantry (AIM) Divisions both with consolidation end without consolidation (denoted baseline system). It elso provides e precise comparison of staffing requirements for each of the four defined elternative systems assuming the TRADOC plen of consolidation detailed in Appendix B is adopted.

Baseline System

At the present time Army units, both divisionel end non-divisional, predominately operate company level field kitchens. The number of food service personnel authorized to operate the company kitchens was based on the unit's Table of Organizetion and Equipment (TOE). The total number of food service personnel required for the 13 Divisions when operating compeny level kitchens was established by summing the requirements for each unit included in the 13 Divisions.

The current Army plenning factor for KP's is two KP's for the first 50 consumers end one additional KP for each 50 consumers (or mejor fraction thereof), thereafter.[16] A number of observetions of field treining exercises have verified that this plenning factor is generelly followed. Based on this planning factor end each unit's TOE strength, the total number of KP's required by the baseline system was established for each of the 13 Divisions.

Based on this enalysis, the 13 AIM Divisions currently require 7362 food service personnel end 5357 KP's to operate their field feeding system. The strength of the 13 Divisions under consideration is 199,200. Therefore, on the average, food service personnel represent 3.70% of the total Division strength while KP's represent 2.69%. In essence, 6.39% (F.S. personnel + KP's) of the troops in e typical Army Division ere dedicated to operating the current field feeding system.

Alternative Systems

All four elternetive systems assume the 13 AIM Divisions restructure their field feeding system according to the TRADOC plen for consolidation es detailed in Appendix B. Based

[16] op. cit. 1

on this plan of consolidation, the number of field kitchens in a typical Army division would be reduced from 105 to an average of 40 as shown in Table 5. The net effect is a 62% reduction in the number of field kitchens. The number of consumers assigned to each of these consolidated kitchens range from 99 to 963 and is also summarized in Table 5. Since all four alternative systems assume the same plan for consolidation, the feeding levels (i.e., the number of consumers assigned to each field kitchen) do not vary between alternatives. Therefore, variations in the staffing requirements between alternatives are the direct result of differences in efficiency and layout of the equipment provided with the alternative systems.

The first step in this analysis was to determine the number of food service and KP personnel required to operate field kitchens of different sizes when provided various food service and sanitation equipment. These staffing levels were based on data from several sources: 1) the work sampling results of two recent field feeding experiments;[17] 2) data from Army and Marine Corps field exercises; 3) data from operational tests; and 4) data from Army and Marine Corps staffing guides.

Using these staffing levels, it was then possible to establish the total number of food service personnel and KP's required for each field kitchen under the plan of consolidation for each of the four alternative systems. Then, by summing the staffing requirements for each field kitchen for a given alternative, the total staffing requirements for the 13 Divisions were established.

With Alternatives I and II, the field kitchens are provided only standard field equipment while with Alternatives III and IV, the field kitchens are provided various non-standard commercial and developmental labor saving items as well as standard equipment. It should be noted that the only difference in the type of equipment authorized for Alternatives I and II is for those kitchens supporting 251–500 troops which are authorized a G.P. medium tent with standard field equipment with Alternative I and two MKT's with Alternative II. However, since none of the labor saving devices are provided with the two MKT's for Alternative II, the staffing requirements for Alternatives I and II are identical. The reduced staffing requirements for Alternatives III and IV, which are provided with labor saving devices, are also identical.

Food Service Personnel

Alternatives I and II

Either Alternative I or II could be adopted by the Army immediately, provided consolidation is implemented and a sufficient number of MKT's is available.[18] These two alternatives utilize only standard field equipment. With both of these alternatives,

[17] op. cit. 2 and 3

[18] At time of publication initial delivery of MKT's was scheduled for early 1977. Until delivery is completed, M–1948 kitchen tents with M–59 Range Cabinets would be utilized.

TABLE 5

Consumer/Kitchen Density Comparison for Consolidation of 13 AIM Divisions

No. Consumers	Infantry[a] Division	Mechanized Division	Armored Division	Total 13 Divisions[b]
99	1	1	0	10
108	2	2	2	26
121	0	0	2	6
122	2	2	0	20
124	0	0	1	3
125	1	0	0	6
146	1	1	1	13
149	3	0	0	18
151	0	0	1	3
154	0	0	4	12
155	0	4	0	16
160	3	3	3	39
172	0	1	0	4
197	1	0	0	6
206	0	1	1	7
209	0	1	0	4
210	0	0	1	3
213	0	1	1	7
227	0	1	0	4
240	1	0	1	9
302	3	3	3	39
311	1	1	1	13
331	1	1	1	13
356	1	0	0	6
375	1	1	1	13
379	0	1	0	4
384	1	1	1	13
385	0	0	1	3
412	1	1	1	13
482	3	0	0	18
515	0	1	1	7
539	0	3	3	21
553	1	4	5	37
598	1	0	0	6
616	1	0	0	6
670	0	1	1	7
797	7	0	0	42
878	1	5	4	38
963	1	0	0	6
TOTAL	39	41	41	521

[a]Number of kitchens

[b]6 Infantry, 4 Mechanized Infantry, 3 Armored Divisions

the lerger size field kitchens ere essentially the same as the standard Marine Corps battalion level field kitchen.

Several observetions of Army field training exercises corroborates the AR 570–2[19] staffing guide for food service personnel for standard company level field kitchens. However, based on the Camp Edwards and Camp Pendleton experiments, 18 food service personnel or four more then authorized by AR 570–2, ere required by a field kitchen utilizing standard equipment when supporting 900 troops. Therefore, new staffing levels, summarized in Table 6, were developed for Alternatives I and II. These staffing levels were obtained by following AR 570–2 for field kitchens supporting up to 224 troops and by utilizing the data from the ebove experiments to establish the staffing requirements for the larger sized kitchens.

Alternatives III and IV

Alternatives III end IV represent improved systems since they utilize e number of non-standard items of equipment (some of which ere electrically powered) which make these systems more efficient. The staffing levels for these alternatives were developed using ell aveileble data as well as productivity measures. It should be noted that the personnel requirements for Alternetives III and IV ere also identical since the labor saving equipment is essentielly identical. The maximum personnel savings with these Alternatives occur above the 850 troop level where there is e savings of four cooks es compared to Alternatives I and II. The overall staffing levels for food service personnel are summarized in Table 6.

KP Staffing

Alternatives I and II

The current Army KP plenning factor was utilized for establishing the KP authorizations for each field kitchen for Alternative Systems I and II, since sanitation equipment primerily consists of the 32 gallon G.I. can with immersion heater and miscelleneous cleaning supplies. All hot water must be menuelly trensferred using laddles and 15 gallon pots es well es 5 gallon cans to carry water from the water trailer to the G.I. cans.

Alternatives III and IV

Due to the introduction of the new sanitation center and other labor saving devices (hot water heater with pump) Alternatives III end IV require significently fewer KP's then the standard systems. For example, the Camp Pendleton work sampling data showed that only 64% as much KP labor (101.4 versus 159.0 productive man-hours daily) was required to operate the XM–75 system as compared to the standard system when

[19]AR 570–2, "Organization and Equipment Authorizetion Tables – Personnel," Headquarters, Department of the Army, Washington, DC, July 1969.

TABLE 6

Food Service Staffing (F.S. MOS)

Alternative Systems I and II		Alternative Systems III and IV	
Consumer Strength	Number Food Service Personnel Authorized	Consumer Strength	Number Food Service Personnel Authorized
0–62	3	0–62	3
63–104	4	63–104	4
105–164	5	105–164	5
165–224	6	165–232	6
225–284	7	233–307	7
285–344	8	308–400	8
345–404	9	401–490	9
405–464	10	491–580	10
465–524	11	581–670	11
525–584	12	671–760	12
585–644	13	761–850	13
645–704	14	851–940	14
705–764	15	941–1030	15
765–824	16		
825–884	17		
885–944	18		
945–1004	19		

supporting 900 consumers. Therefore, to take into account the improved efficiency inherent in Alternatives III and IV, the KP planning factor was adjusted downward to 2 KP's for the first 75 troops being supported and 1 KP for each additional 75 troops or major fraction thereof. It should be noted that the exact cut-off point should have been 78 troops, however this was rounded down to 75 to be more conservative.

Based on the distribution of kitchen sizes after consolidation (see Table 5), the food service personnel staffing requirements (see Table 6), and the KP planning factors discussed previously, the number of food service personnel and KP's required by the 13 AIM Divisions for each alternative system were computed and are summarized in Table 7.

Non-Food Service Personnel

The intermediate and large size kitchens in the improved systems of Alternatives III and IV require a generator since several of the labor saving devices are electrically powered. However, the provision of a generator creates an additional workload which does not exist with either standard alternative, that is operation, maintenance and repair of the generators. It is important to note that no operator is provided in the staffing for the improved systems since it is assumed that a cook would be cross trained to operate and perform preventive maintenance on a 10 kw generator. The rationale for this is that preventive maintenance for a generator is much less than a full time job. However, based on AR 570–2, a 10 kw (10 kw is more than sufficient) generator requires 620 man-hours organizational maintenance, 167 man-hours Direct Support maintenance and 101 man-hours General Support maintenance for a total of 888 man-hours of maintenance per year. Since one man-year provides 2500 productive man-hours, the maintenance labor for one 10 kw generator is equivalent to approximately 0.35 man-years. In a typical Division, 24 generators would be required to support kitchens with over 250 customers. Thus 9 additional generator maintenance personnel would be necessary per division, which would slightly reduce some of the additional savings associated with Alternatives III and IV.

Supervisory Personnel

A large consolidated kitchen serving 450–900 customers represents a 3–5 fold increase in the magnitude, scope and complexity of operations over a typical company-size kitchen. The level of organization, equipment and staffing of such large operations are clearly beyond the level of supervision normally assigned to an E–7. Consequently, all of the large kitchens (450 customers or greater) were assigned a dining facilities manager (E–8) for Alternatives I–IV. This can be seen in Tables C–1 through C–3, in which there is an increase in E–8's and decrease in lower grade levels for Alternatives I–IV over the baseline.

TABLE 7

Food Service Personnel and KP's: Requirements and Savings For 13 AIM Divisions

Personnel Category	Baseline	Alternatives I and II	Alternatives III and IV
Food Service	7362[a]	4967[a,b]	4404[a,b]
KP's	5357	4563	3195
Total	12,719	9530	7599
SAVINGS			
Food Service	–	2395 (33%)	2958 (40%)
KP's	–	794 (15%)	2162 (40%)
Total	–	3189 (25%)	5120 (40%)

[a]Includes the 9 food service personnel per division with MOS's 94Z50, 941A, and 4130 who are currently authorized each division.

[b]Includes five additional cooks (94B20) per division, 1 per Brigade Hq and 2 per Command Operating Company who operate 24 hour messes.

Conclusions

1. Alternatives I and II will reduce the number of divisional food service personnel required by 2395 (33%), the number of KP's required by 794 (15%), and the total food service and KP staff by 3189 (25%).

2. Alternatives III and IV will reduce the number of divisional food service personnel required by 2958 (40%), the number of KP's required by 2162 (40%) and the total food service and KP staff by 5120 (40%).

3. To obtain the additional savings in food service personnel and KP's associated with Alternatives III and IV as compared to Alternatives I and II, some additional generator repairman, estimated to be approximately 9 per Division, are required.

CHAPTER IV

GARRISON AND FIELD STAFFING COMPATABILITY

Introduction

One problem which must be considered with eny concept of consolidated field feeding is the compatability of the proposed food service staffing levels with the staffing requirements of garrison feeding. This problem may be restated in the following manner: "Can e division operating under the proposed food service staffing levels of this report meet the labor requirements of garrison feeding?" If the answer to this question is positive, then no problem exists. However, if the enswer to this question is negative, then augmentation by civilian cooks and/or contract food service personnel would be necessary in tha garrison situation.

Tha Army hes now consolidated many of its garrison dining halls ebove the company level. This consolidation has been accomplished as a result of two factors. First, the construction of large dining facilities ellows the feeding of multiple units in a single dining facility. Secondly, a low attendance rate at many garrison dining halls has allowed more than one unit to be assigned for subsistence to e single unit size dining facility.

One example of consolidation in garrison is the 2nd Armored Division stationed at Fort Hood, Texas, which currently[20] operates only 19 garrison dining halls for the entire division. A typical AIM division is currently authorized approximately 105 dining facilities, whether in garrison or in the field. This reduction in facilities from 105 to 19 represents a little greater than a one for five consolidation of dining facilities. Using the 2nd Armored Division, a specific analysis has been made to determine whether the staffing levels proposed in Chapter III would be sufficient to support their current garrison food service system.

Existing Garrison System

The Second Armored Division, as of July 1976, was operating 19 garrison dining facilities; six having capacity for 240 customers, ten with capacities for 276 customers, and three with capacities for 1000 customers. Table 8 provides the dining hall number, rated capacity, personnel authorized to subsist, e monthly (July, 1976) average headcount per meal, and the number of cooks assigned for each of the dining facilities operated by the Division. It is interesting to note that: (1) the total rated dining hall capacity is 47% of the total personnel authorized to subsist; (2) all dining halls have capacities

[20] As of August, 1976.

TABLE 8

Dining Hall Data, 2nd Armored Division

Dining Hall Number	Rated Capacity	No. of Troops Assigned	July 1976 Average Headcount[a]
9210	240	1034	204
9418	276	564	223
9420	276	528	184
9423	276	980	163
9424	276	583	155
9425	276	626	151
10001	276	899	249
10003	276	241	57
10008	276	1027	244
10007	276	988	250
10016	240	1227	185
10020	276	858	201
12005	1000	1800	390
12007	1000	798	196
14019	240	538	154
14020	240	517	167
14022	240	465	171
14023	240	519	142
16007	1000	1059	328
TOTALS	7200	15250	3794

[a]Headcount average is for a single meal.

which fall into three sizes – 1000, 276 and 240 customers; and (3) the total average headcount is only 25% of the total enlisted population. These figures indicate an average attendance rate of 26% and an expected maximum attendance of 47% for the entire Division in garrison.

Estimation of Garrison Staffing

An estimation of the required food service personnel using the data of Table 8 will be made using the following assumptions:

1. Sufficient food service attendants (KP's), military and/or civilian, are provided to the garrison dining facilities in accordance with AR 30–1.[21]

2. The division food service office will have the ability to assign and reassign food service personnel to garrison dining halls on the basis of labor requirements, not on the basis of the units consolidated in a dining hall.

Two sources[22,23] will be used to develop staffing requirements for the division. From each source staffing levels will be calculated using both divisional dining hall headcounts and dining hall capacities as demand criteria. The results of these calculations are presented in Table 9.

Compatability with Proposed Field Staffing

Table 6 of Chapter III contains the proposed food service staffing for the various size field kitchens under Alternatives I and II (Standard Systems) and Alternatives III and IV (Improved Systems). Using this table and the plan for consolidations for Armored Divisions detailed in Appendix B, the food service staffing can be calculated for each alternative. Table 10 presents a comparison between field staffing proposed under each alternative for an Armored Division with the estimated garrison staffing levels for the 2nd Armored Division.

[21] AR 30–1, "The Army Food Service Program", Department of the Army, April 1971.

[22] Pamphlet No. 570–551, "Staffing Guide for US Army Garrisons", Headquarters, Department of the Army, May 1973.

[23] AFM 26–3, "Air Force Manpower Determinates", HQ Department of the Air Force, Washington, DC, April 1971.

TABLE 9

Garrison Food Service Staffing: 2nd Armored Division

Dining Hall Number	Presently Assigned	PAM 570–551 By Headcount	PAM 570–551 By Capacity	AFM 26–3 By Headcount	AFM 26–3 By Capacity
9210	25	14	15	12	13
9418	15	15	16	13	15
9420	24	13	16	11	15
9423	23	12	16	10	15
9424	21	12	16	10	15
9425	32	12	16	10	15
10001	33	15	16	14	15
10003	6	7	16	5	15
10008	28	15	16	14	15
10007	36	16	16	14	15
10016	39	13	15	10	13
10020	26	14	16	12	15
12006	45	19	32	19	36
12007	24	14	32	12	36
14019	23	12	15	10	13
14020	29	13	15	10	13
14022	22	13	15	11	13
14023	25	12	15	9	13
16007	37	18	32	17	36
TOTALS	513	259	346	223	336

TABLE 10

Comparison of Field and Garrison Staffing for Food Service Personnel

		Army		Air Force	
	Proposed Consolidated Field Staffing	By Headcount	By Capacity	By Headcount	By Capacity
Alternatives i and II	366	259	346	223	336
Aiternatives Iii and iV	325	259	346	223	336

It can be seen from Table 10, that the oniy case where the proposed field staffing wiii not meet garrison requirements is under Aiternatives III and iV when staffing has been calculated to meet full capacity demand. Since this requirement will rareiy (if ever) occur, the authors consider that staffing soiely for full capacity cannot be economicaiiy justified. By comparison, the 2nd Armored Division currently operates with an assigned strength of 513 cooks for garrison dining facilities. This figure is 48% greater than the maximum requirement of 346, which is a worst case situation.

Other Considerations

One major concern of a consolidated garrison dining situation is the problem of depieting cooks from a dining hali when a unit goes to the field for exercises. The division food service office must have the authority to either reassign the remeining units or a portion of the remaining units to other dining haiis in order to compensate for the depletion of cooks. Another option open to the division food service office should be the authority to reassign both the remaining cooks and units to other dining faciiities, and temporeriiy ciose the dining facilities being depieted.

Conclusions

1. The 2nd Armored Division would have a sufficient garrison food service staffing under aii four aiternatives.

2. The Division Food Service Office must have effective controi over the assignment and reassignment of both cooks and units to garrison dining hails.

CHAPTER V

ECONOMIC ANALYSIS OF ALTERNATIVE SYSTEMS

The intent of this analysis is to establish the cost of each alternative. In the cost analysis, the total annuel cost of providing food service to thirteen AIM Divisions is derived using widely accepted economic analysis methods. It is important to note that the TRADOC European scenario was employed to develop reasonable transportation costs. In tha next chapter, e model of systems effectiveness will be determined end applied to the elternative systems considered in this analysis. This cost analysis, combined with the systems effectiveness model, will be used to determine e preferred elternative.

Economic Analysis

A uniform annuel cost method will be used es a basis to compare the cost of each system. Annual costs have the advantage of incorporating into a single figure the investment and recurring costs associated with each elternetive.

Assumptions

The following assumptions were made in performing this analysis:

1. The discount rate is 10%.

2. Salaries, benefits, end ell other costs remein constant over the period of enalysis.

3. Tha menu selected is essumed to remain the same for ell elternatives.

4. Troop strengths remein constant over the period of analysis.

5. The age of equipmant presently authorized and in use is homogeneous (i.e., some items are new, while others approaching wearout ere about to be repleced with the remainder equelly distributed between these extremes). Thus, the annuel investment expenditure for replacement of existing equipment is governed by the ratio C/L where C is the cost of the equipment in dollars and L is its economic life in years.

6. Disposable mess gear will be used at remote sites and nondisposable trays will be used at the centrel sites where the kitchens are located.

Cost Elements

The following elements have been identified as major cost ereas in the field feeding system studies.[24]

[24] op. clt. 7.

1. Labor

2. Food

3. Equipment

4. Fuel

5. Transportation

6. Disposables

7. Water

The following elements were used to calculate labor costs:

1. Salary and Benefits

2. Support

3. Training

4. Rotation

5. Initial Clothing and Accession

These elements were combined to obtain a uniform annual labor cost for each MOS and pay grade that is used in staffing a kitchen system. The detailed annual labor cost calculations are shown in Appendix C. The manpower and staffing requirements in Chapter III were used in computing labor costs for both the present and consolidated systems.

Food costs were calculated on a mix of "A" rations, "B" rations, and "MCI" (Meal Combat Individual). An assumption here is that "B" rations will be used during the initial month and then replaced with "A" rations for the remainder of the operation. Food costs are based on July 1976 prices. The detailed calculations for food and other costs with the exception of equipment and labor, can be found in Appendix E.

The equipment cost was analyzed in two categories, equipment which is presently being used in the conventional system and that which is being introduced in the alternative

systems. The annual costs for the equipment in the conventional system were calculated by divlding the cost of the equipment in dollars by its economic life in years.[25] The annual costs for new equipment were calculated by taking into account the purchase price, economic life, and the discount rate of the investment dollars. The discount rate and the economic life were used to calculate the capital recovery factors. The capital recovery factors can be obtained from tables or computed from the formula.[26]

$$\text{Capital Recovery Factor} = \frac{i(1+i)^n}{(1+i)^n - 1}$$

where i is the discount rate

and n is the economic life in years.

The annual equipment costs were then obtained by multiplying the capital recovery factor times the purchase price of the equipment item. The annual cost comparison provides a common denominator for economic decisions and a tool for budget planning and control. Appendix D presents a detailed calculation of equipment costs.

Fuel costs are based on the fuel consumption rates of the equipment assigned to each system. These costs have been adjusted to reflect reduced consumption for the period of time that the troops are subsisting on individual operational rations. The cost per gallon is the price delivered in Europe.

Transportation costs per ration were obtained from an analysis of the existing system.[27] These include shipping the food or disposables from the US through port of entry to the rear depot. Semi-trailers then deliver the items forward to the brigade trains.

All alternative systems employ the same mix of disposable mess gear. At the kitchen site, stainless steel trays, and disposable utensils and cups are used. Remote sites will use disposable trays, utensils, and cups. The costs of the items are based on GSA prices.

Water consumption is based on the size of the kitchen, the sanitation equipment employed, and the extent to which disposables are used. The cost per gallon of water is calculated based on the labor costs of the troop units providing the water.

[25] SB 10–496, Supply Control – Replacement Factors, Headquarters, Department of the Army, November 1972.

[26] Berish, Norman N., Economic Analysis, McGraw-Hill Book Company, New York, 1962.

[27] op. cit. 7.

Two cost areas relating only to the alternatives will be taken into consideration. One area is the increased electrical power requirements of Alternatives III and IV. Secondly, the additional labor needed by Alternatives I – IV for feeding at remote sites will also be considered.

Capital Investment

The initial investmant requirements of an alternative system can be a prime consideration in any cost benefits study. The following table presents the equipment investment requiramants for the Army's 13 AIM Divisions. It should be noted that the alternativa systems include items already available in the baseline system.

TABLE 11

EQUIPMENT INVESTMENT COSTS

System		Cost (Millions of Dollars)
Baselina		$22.826
Alternative	I	21.406
	II	23.257
	III	29.771
	IV	29.291

Results

Table 12 presents tha annual food service system costs for the baselina and alternativa systems for the Army's 13 AIM Divisions.

TABLE 12

Annual Food Service System Costs for 13 AIM Divisions (Millions of Dollars)

Cost Component	Baseline	Alternatives I	II	III	IV
1. Labor (Food Service Mos.)	$109.483	$ 72.535	$ 72.535	$ 65.020	$ 65.020
2. Labor (KP)	59.522	50.699	50.699	35.500	35.500
3. Food [a]	202.128	198.892	198.892	196.933	196.933
4. Equipment Amortization	5.806	5.562	6.196	8.314	8.081
5. Fuel	15.456	11.960	12.684	8.052	8.052

TABLE 12 (cont'd)

Annual Food Service System Costs for 13 AIM Divisions (Millions of Dollars)

Cost Component	Baseline	Alternatives I	II	III	IV
6. Disposables	–	13.106	13.106	12.977	12.977
7. Transportation (Food)	26.684	26.257	26.257	25.998	25.998
8. Transportation (Disposables)[b]	–	1.780	1.780	1.763	1.763
9. Water Cost	2.795	1.539	1.539	1.514	1.514
10. Electrical Equipment	–	–	–	.121	.121
11. Augmented Labor[c]	–	1.447	1.447	1.447	1.447
Total Annual Cost	$421.874	$383.777	$385.135	$357.639	$357.406
Total Annual Savings Compared to Present System	–	$ 38.097	$ 36.739	$ 64.235	$ 64.468

[a]Differences in food costs reflect labor savings achieved through consolidation.

[b]Includes storage cost of disposables.

[c]Labor costs for distribution of food to remote sites.

Conclusions

1. Each alternative system represents a significant savings when compared to the baseline system. This savings is primarily a direct result of the personnal savings inherent in consolidation as well as the labor saving capabilities of the alternative systems.

2. Alternatives III and IV provide the greatest savings on an annual basis, $ 64.235 and $64.468 million, respectivaly. This increase in savings is primarily dua to the reduction in labor costs which are a direct result of the labor saving devices provided with Alternatives III and IV. Further, the labor savings of these alternatives more than offset

the capital recovery of the new equipment items. The slight difference in savings between Alternatives III and IV is directly attributable to the increased amortization cost of equipment for Alternative IV, since the multiple Mobile Kitchen Trailer (MKT) combination is a more costly investment than the XM–75 system.

3. Alternatives I and II while providing annual savings of $38.097 million and $36.739 million, respectively, do not allow the opportunity to achieve the level of savings provided with the improved operational capabilities of Alternatives III and IV.

CHAPTER VI

SYSTEMS EFFECTIVENESS ANALYSIS

When alternate approaches to meeting e requirement ere proposed, it is frequently very helpful to decision makers if a methodology is avelleble to evaluate the comparative effectiveness and cost benefits of these elternatives. Anelysis of the overall effectiveness of each alternetiva system is necessary before the total impact of consolidation can be determined. The factors to be considered generelly concern the impact of new concepts on overell performanca, trends in effectiveness es related to the baseline system as well as cost end performance limits. The desired result is to renk the elternative systems in order of preference based on cost and systems affectiveness. The overall eveluation must include consideration of non-quentifieble factors as well as enalysis of quantitative data.

Sinca a cost enalysis of the elternative systems is presented in e prior chapter, this chapter will present the systems effectiveness analysis end the integration of the two alements into a relativa worth detarmination. The effectiveness of e system is the degree to which the ebility of e forca to perform its mission is improved or degraded by the introduction of the system.[28] A model of systems effectiveness has been determined for the present and alternative systems. A schematic of this modal is shown in Figure 2. The three main paramaters of this model are performance, human factors, and maintainability/reliebility. A measure of effectiveness was determined for each of these paramaters. Each of these peremeters were subdivided into a series of effectiveness factors. These individual factors wera weighted with a point score between .05 and .20 in terms of their importance in the effective operation of e field feeding system. The measure of effectiveness for each parameter end the total system wera determined by the weighted summation of these effectiveness factors. It is noted that tha weightings given to the various system effectiveness factors ere based upon the results of field experimentation[29] and when hard data were not available, the judgment of the authors. Tha reader is encouraged to establish his own weightings and recalculate the effectiveness ratings. The effectiveness factors of this model are described es follows:

1. Productivity is the measured output in a number of meals per man hour of affort (weighted as .20).

[28] Cost and Operationel Effectiveness Analysis Handbook, United States Army Training and Doctrine Command, Pamphlet 11–8, Fort Monroe, Virginie 23651.

[29] op. cit. 2 and 3.

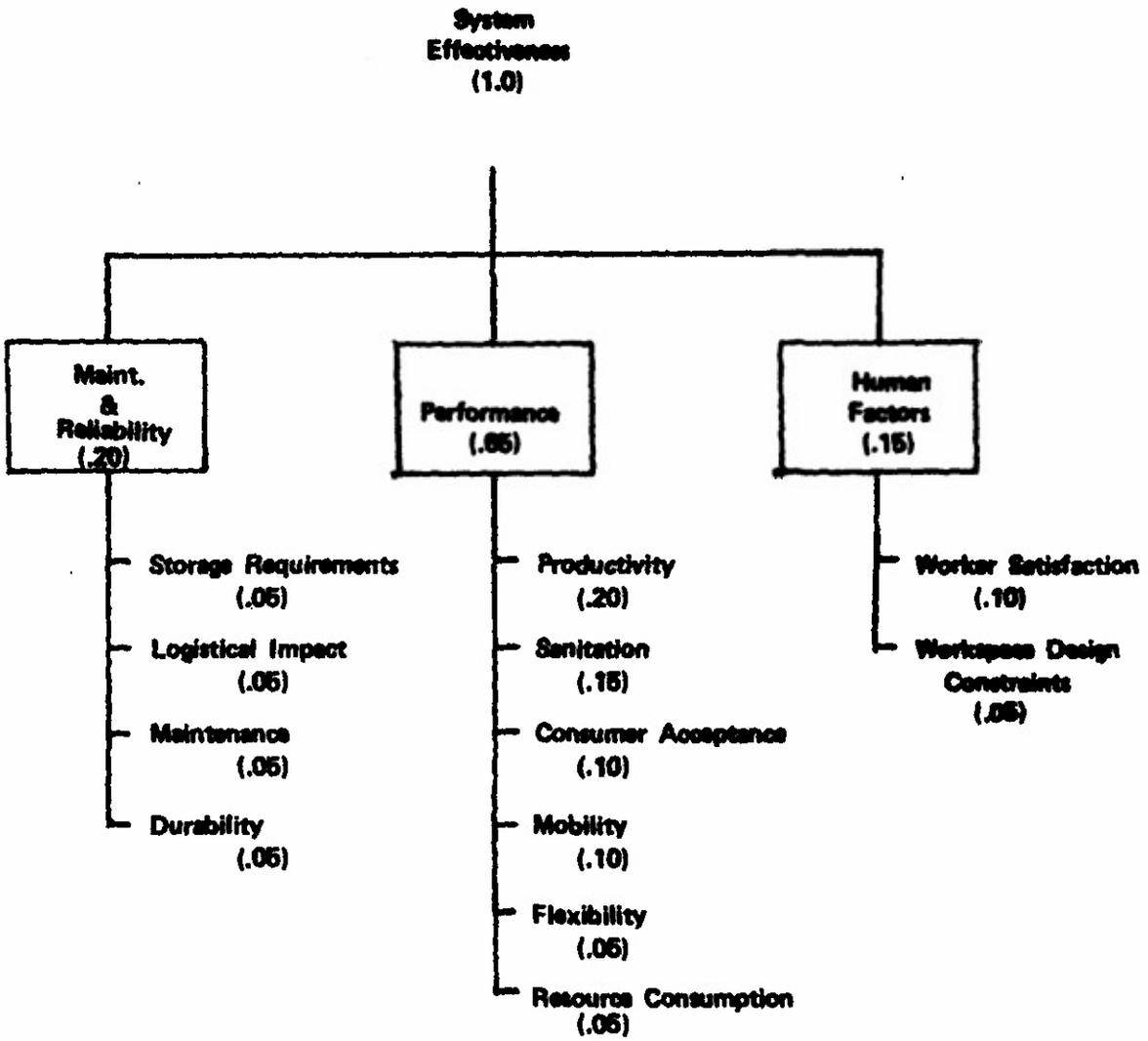


FIGURE 2

Field Feeding Systems Effectiveness Model

2. Sanitation is evaluated as the effort required to accomplish all sanitation tasks, excluding individual mess gear; effectiveness of sanitation equipment; and microbiological assessment (weighted as .15).

3. The consumer acceptence is the quality of the food as evaluated by consumers at remote sites (weighted as .10).

4. Mobility is the total amount of time required to displace a kitchen system, including tear down, on-loading, off-loading, and set-up (weighted as .10).

5. Worker satisfaction is the overall worker assessment of the work environment of each system (weighted as .10).

6. Workspace design constraints assess the adequacy of achieving human factors criteria as specified in MIL-STD-1472B (weighted as .05).

7. Resource consumption is the amount of fuel and water required daily (3 meals) for cooking and kitchen sanitation (weighted as .05).

8. Storage requirement is the cube of the systems (weighted as .05).

9. Logistical impact is the provisioning, spare parts and transportation requirements of each system (weighted as .05).

10. Maintenance is a measure of the level of effort required to maintain a field feeding system (weighted as .05).

11. Durability is a measure of the system's ability to withstand repeated performance of the mission (weighted as .05).

12. Flexibility is the capability to tailor the system to meet various work loads and the capability to operate at two widely separated locations with each increment properly tailored to support assigned work load (weighted as .05).

The prime sources of data for input into the systems effectiveness model are the Camp Edwards and Camp Pendleton Field Feeding Experiments as well as observations of operational tests and training exercises. Numerical values were assigned to each alternative system based on the following comparison to the present system:

+3 Significant improvement relative to present system

+2 Improved performance relative to present system

+1 Equivalent performance relative to present system

−1 Degradation in performance relative to present system

−2 Significant degradation relative to present system

The weighted values were then computed by multiplying the numerical performance value by the relative weight to obtain the results shown in Table 13. For example, the value of productivity of Alternative I is obtained by assigning a numerical performance value of +2 and a weight of 0.20. The product of these two values yield the resultant weighted performance value of 0.40.

Comparison of Alternative Systems

Table 13 presents a comparison of the rating of the alternative systems. All of the alternative systems exhibit operational effectiveness scores superior to the Baseline system. Alternative III has the highest rating (1.90), followed by Alternatives IV, II, and I, with respective ratings of 1.80, 1.15 and 1.10 compared to a baseline present system score of 1.00.

Up to this point, the cost analysis and the systems effectiveness have been treated separately. The ideal relationship is to integrate both measures and produce a relationship indicating the cost of achieving a certain level of effectiveness. This relationship is usually expressed as a ratio and is valuable in providing guidance for decision makers.

The main purpose of this analysis is to determine the extent to which consolidated alternative field feeding systems improve the Army when compared to their present capability. Relative worth of a system is a means frequently employed in developing cost and systems effectiveness analysis to be used by decision makers for making comparisons between competing systems.[30] This technique is used as part of the analysis for the field feeding systems. Relative worth is a combination of the relative cost and effectiveness of each system. Relative cost is the ratio of the alternative system divided by the cost of the conventional system. Relative effectiveness is the same type of ratio using the measures of systems effectiveness. The relationships are as follows.[31]

[30] Op. Cit. 28.

[31] Op. Cit. 28.

TABLE 13

Summary of System Effectiveness for Alternative Field Feeding Systems

Factor	Weight	Alternatives I	II	III	IV
1. Productivity	.20	+2/.40	+2/.40	+3/.60	+3/.60
2. Sanitation	.15	+1/.15	+1/.15	+3/.45	+3/.45
3. Consumer Acceptance	.10	+1/.10	+1/.10	+1/.10	+1/.10
4. Mobility	.10	+1/.10	+2/.20	+2/.20	+2/.20
5. Worker Satisfaction	.10	+1/.10	+2/.20	+3/.30	+3/.30
6. Human Factors	.05	+1/.05	+2/.10	+3/.15	+3/.15
7. Resource Consumption	.05	+2/.10	+2/.10	+2/.10	+2/.10
8. Storage Requirement	.05	+1/.05	−1/−.05	−1/−.05	−1/−.05
9. Logistical Impact	.05	+2/.10	+2/.10	+2/.10	+2/.10
10. Maintenance	.05	−1/−.05	−2/−.10	−1/−.05	−2/−.10
11. Durability	.05	−1/−.05	−2/−.10	−1/−.05	−2/−.10
12. Flexibility	.05	+1/.05	+1/.05	+1/.05	+1/.05
Total Systems Effectiveness		1.10	1.15	1.90	1.80

$$\text{Relative Cost} = \frac{\text{Annual Cost of Alternative System}}{\text{Annual Cost of Conventional System}}$$

$$\text{Relative Effectiveness} = \frac{\text{Effectiveness of Alternative System}}{\text{Effectiveness of Conventional System}}$$

$$\text{Relative Worth} = \frac{\text{Relative Effectiveness}}{\text{Relative Cost}}$$

Relative worth normalizes the cost and operational effectiveness relationships such that the conventional system is assigned a value of one. A new system is considered preferable to the old when the relative worth is greater than one. The calculation of these ratios is shown in Table 14. Annual costs were obtained from the previous chapter.

TABLE 14

Cost and System Effectiveness Comparison for 13 AIM Divisions

		Alternatives			
	Baseline	I	II	III	IV
Annual Cost (Millions)	$421.874	$383.777	$385.135	$357.639	$357.406
Relative Cost	1.0	.91	.91	.85	.85
Relative Effectiveness	1.0	1.10	1.15	1.90	1.80
Relative Worth	1.0	1.21	1.26	2.23	2.12
% Increase in Relative Worth Compared to Baseline System	–	21%	26%	123%	112%

Conclusions

Table 14 summarizes the results of this analysis from which the following conclusions were drawn:

1. On the basis of cost and systems effectiveness, all of the consolidated systems are superior to the present baseline system of company level feeding.

2. Alternative III, which utilizes the MKT with the new sanitation center for the small kitchen, the XM–75A for the intermediate kitchen, and the XM–75 for the large kitchen is the preferred choice for a field feeding system. Alternative IV which replaces the XM–75A with two MKT's follows closely as a second choice.

3. The increase in relative worth is 123% for Alternative III and 112% for Alternative IV, as compared to the baseline system.

APPENDIX A

EQUIPMENT DESCRIPTION

GP Medium Kitchens

The intermediate and large kitchens of Alternative I will be housed in GP Medium Tents. The intermediate size kitchen will be housed in two GP medium tents, one for cooking and a second for sanitation and dry storage. The large kitchen will have a third GP medium tent to house serving lines for onsite feeding.

Both the intermediate and large kitchens will use standard Army field kitchen equipment for cooking which will be issued by kitchen customer strength in accordance with AR 310–34.

Sanitation equipment will consist of immersion heater and GI cans issued on the basis of MIL-HDBK-740 which specifies one wash line per 80 persons. Table A-1 presents a list of major equipment provided for a kitchen for 400 men and one for 800 men.

TABLE A–1

Major GP Medium Equipment Items

Item	400 Troops	800 Troops
GP Medium Tent	2	3
Field Range Complete[a]	6	9
Immersion Heaters	20	40
GI Cans	20	40

[a]With M–2 burner.

MKT Kitchens (Standard)

The MKT, designed to support company level feeding, is a self contained trailer mounted field kitchen consisting of standard field feeding equipment packaged in a configuration to allow efficient preparation, storage, and serving of A or B-ration type meals. The MKT is designed and equipped to provide three hot meals daily for up to 300 individuals. Horizontal expansion of the MKT provides the necessary working area and a serving line. A manually raised roof with fabric sides and screening provides environmental protection. Vents are provided in the roof of the MKT. The MKT utilizes a standard M103A3 trailer chassis and is designed to be towed by a standard 2–1/2 ton tactical vehicle. One MKT, with cooking equipment, weighs approximately 5700 pounds.

The major items of equipment provided on a MKT are detailed in Table A–2. An exterior view of a single MKT is depicted in Figure A–2. Interior layouts of e single and double MKT kitchen are sketched in Figures A–3 and A–4.

TABLE A–2

Major MKT Equipment Items

Item	Number
Griddle	1
Cooking Rack	4
Field Range Complete	2
M–2 Burner	4
Fixed Cabinet	1
Moveable Cabinet	2

MKT Kitchens (Modified)

The modified single MKT kitchen would come equipped with a sanitation center which is described later in this Appendix. The modified double MKT kitchen would also come equipped with a sanitation center and the following electric devices: meat slicer, vegetable cutter, and can opener.

XM–75 and XM–75A

Both the XM–75 and XM–75A come equipped with a kitchen, sanitation center, and storage shelter which are described below.

Kitchen: The XM–75 kitchen is housed in a sectional, lightweight, frame-supported shelter. This shelter is basically a standard Army expandable frame type tent modified to provide improved ventilation and access. The shelter consists of five sections, each 17'W x 8'L, making the complete shelter 17' x 40'. A total of eight doorways are provided, two at each end and one on each side of both the second and fourth sections. The two door sections have zippered closures and are equipped with screens with velcro closures. The remaining three sections have large permanently screened windows on both sides and are equipped with clear plastic panels with velcro closures for inclement weather. In addition, fabric with velcro closures can be dropped over the windows for blackouts.

Window fabric, plastic window panels, doorway fabric, and doorway screens can be rolled up and tied when desired. Each section also has a large screened vent with fabric covering on each side of the roof panel to permit the hot air and gas to escape. The fabric covering on the vents is adjustable to provide the desired amount of ventilation. Environmental and blackout protection are provided by a large fly which is approximately 12 inches above the shelter end which extends beyond each end of the shelter.

The XM-75A kitchen is housed in the same basic shelter as the XM-75. However, only four 8' sections are used, making the complete shelter 17' x 32'. The major items of equipment provided with the XM-75 and XM-75A are detailed in Table A-3.

TABLE A-3

Major XM-75/75A Kitchen Equipment Items

Item	XM-75	XM-75A
Griddle	4	2
Steam Table	4	2
Field Range, Complete	10	8
M-2 Burner	6	4
Table, Stainless Steel	10	6
Meat Slicer, Electric	1	1
Vegetable Cutter, Electric	1	1
Can Opener, Electric	1	1

An exterior view of the full size XM-75 shelter is depicted in Figure A-5. Figure A-6 depicts an interior layout of the XM-75 kitchen which was used during an experiment at Camp Pendleton, California. It should be noted that the equipment provided is all modular, thus can be arranged in many possible configurations.

Sanitation Center: A sanitation center, for the washing and sanitizing of pots, pans, insulated food containers, utensils, and other items of equipment, is provided as part of the XM-75/75A systems. The sanitation center is also housed in an expandable frame type tent which consists of two 17'W x 8'L sections of the same design as those used in the kitchen shelter. The equipment provided is listed in Table A-4 and depicted in Figure A-7.

TABLE A–4

XM–75/76 Sanitation Center Equipment List

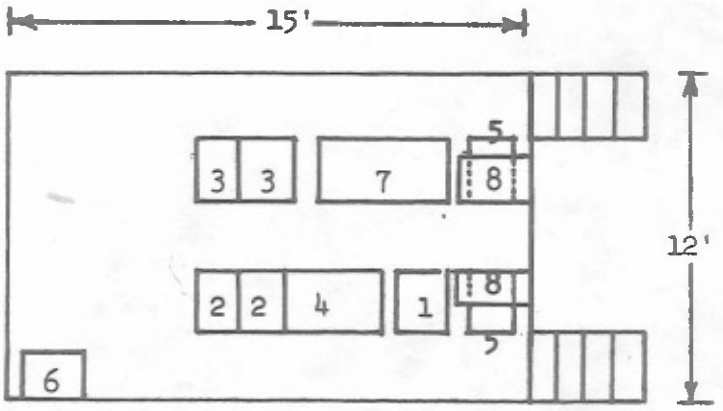
Item	Quantity
Field Kitchen Sink	4
Drain Table	3
Wire Shelving	4
M–2 Burners	4
Hot Water Heater (Outside)	1
Pump with Necessary Hoses (Outside)	1

Four non-stendard stainless steal field sinks are set up to provide for prewashing, washing, rinsing, and a sanitizing rinse. Metal cradles ara used to support the sinks end hold M–2 burner units used for maintaining water temperature. Tha wash lina includes three stainless steel work tablas, which are connected to tha sinks. Tha sinks, 24"L x 24"W, are large enough to immarse tha largest cookware (the 15-gallon pot) currently in tha system. In addition, four sets of wira shelving are set up in the sanitation cantar for storing and drying sanitized itams. A standard water heater with pump is used to provide e continuous supply of 180°F water.

Storage Shelter: A 17'W x 16'L shalter of tha sama design as the sanitation shelter is provided for tha storage of non-parishabla subsistance items and miscellaneous supplies. Supplies are placed on wooden pallets.

Figure A—1. Large GP Medium Kitchen: Exterior View

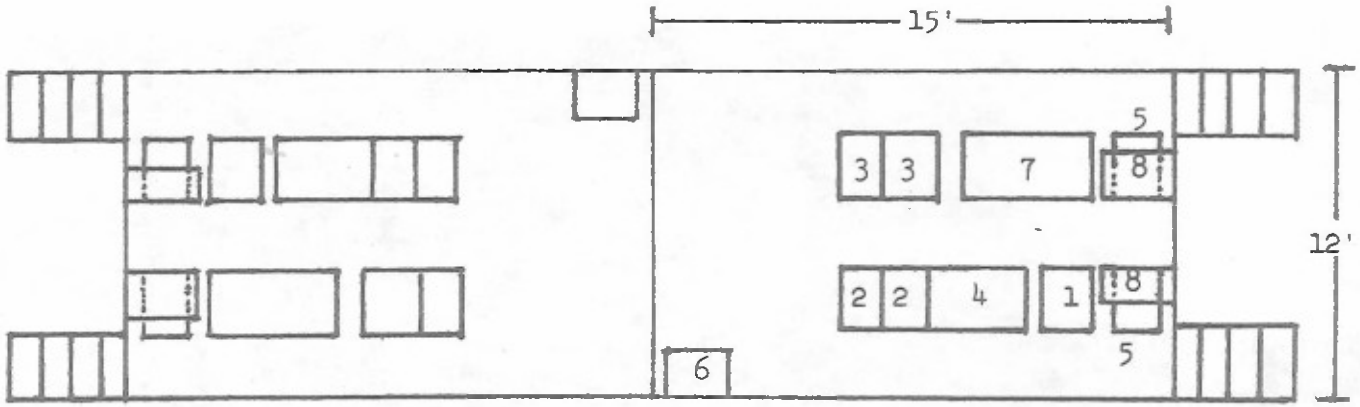
Figure A–2. MKT: Exterior View



Legend

1 - Condiment Cabinet
2 - Cooking Rack
3 - Field Range
4 - Griddle
5 - Ice Chest (under)
6 - Moveable Storage Cabinet
7 - Storage Cabinet
8 - Drop-leaf Table

Figure A-3. Layout of MKT Kitchen



Legend

1- Condiment Cabinet
2- Cooking Rack
3- Field Range
4- Griddle
5- Ice Chest (under)
6- Moveable Storage Cabinet
7- Storage Cabinet
8- Drop-leaf Table

NOTE: Equipment layout is identical on each MKT.

Figure A-4. Layout of a Double MKT Kitchen

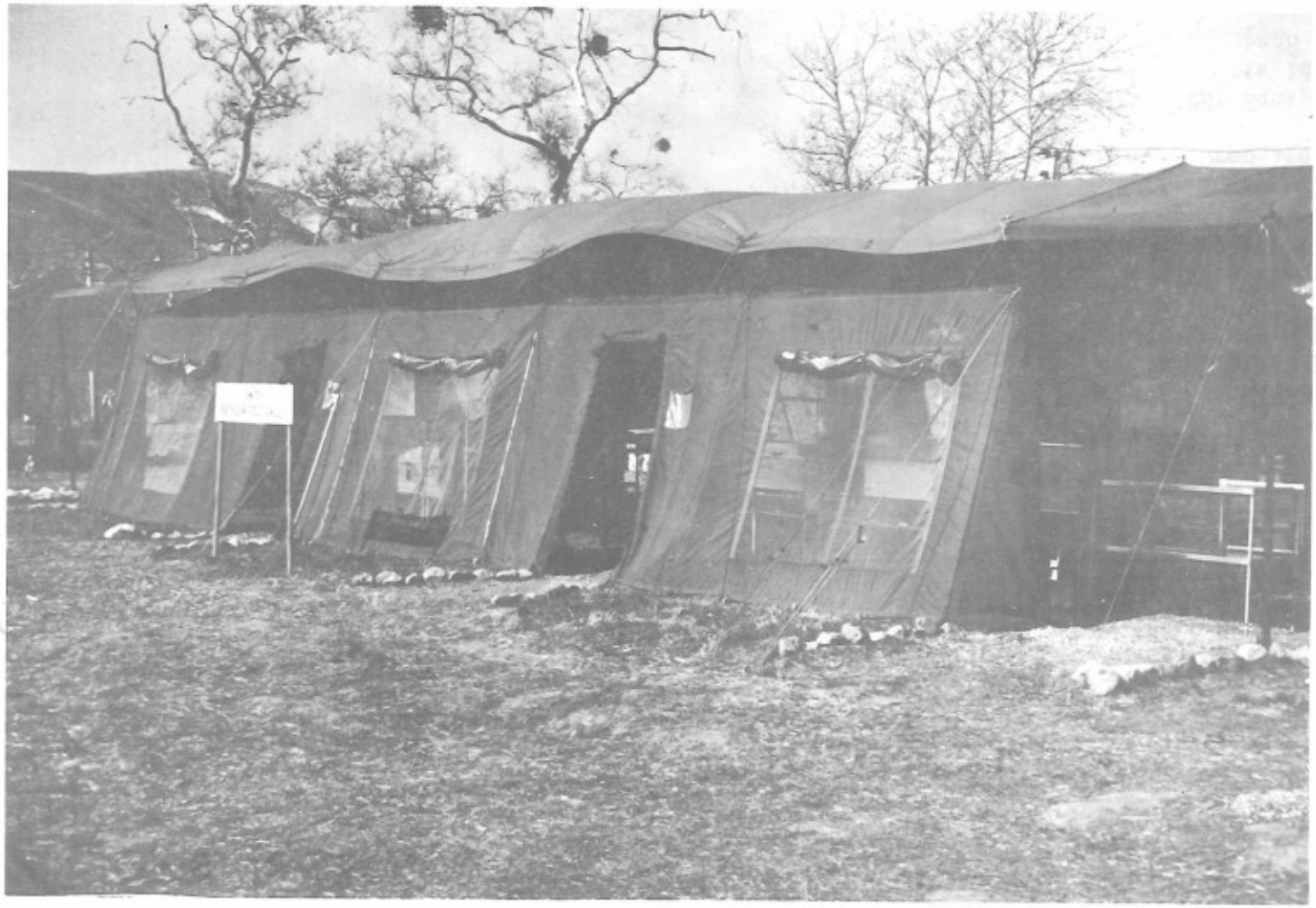


Figure A–5. XM–75 Kitchen: Exterior View

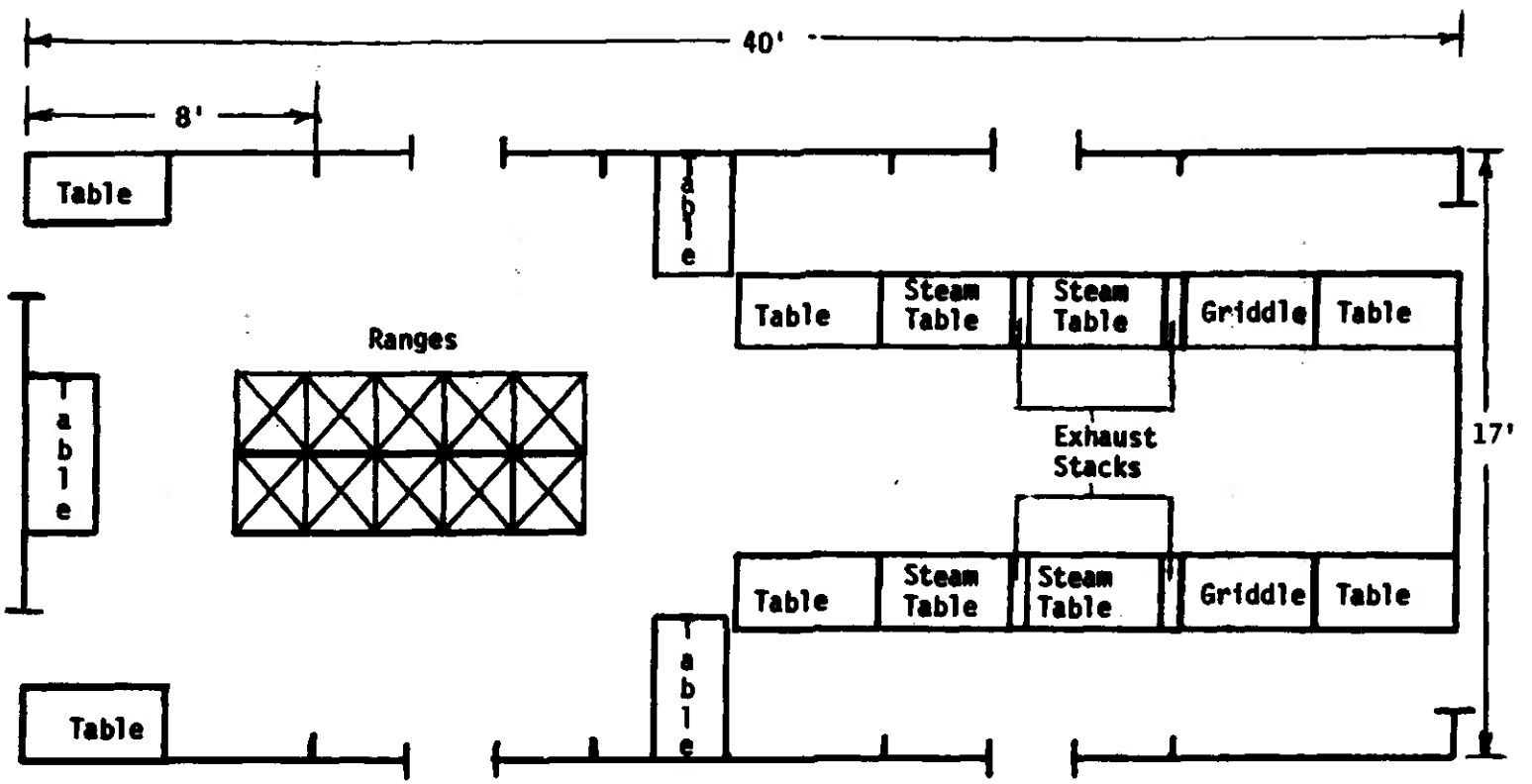


Figure A-6 Layout of XM-75 Kitchen

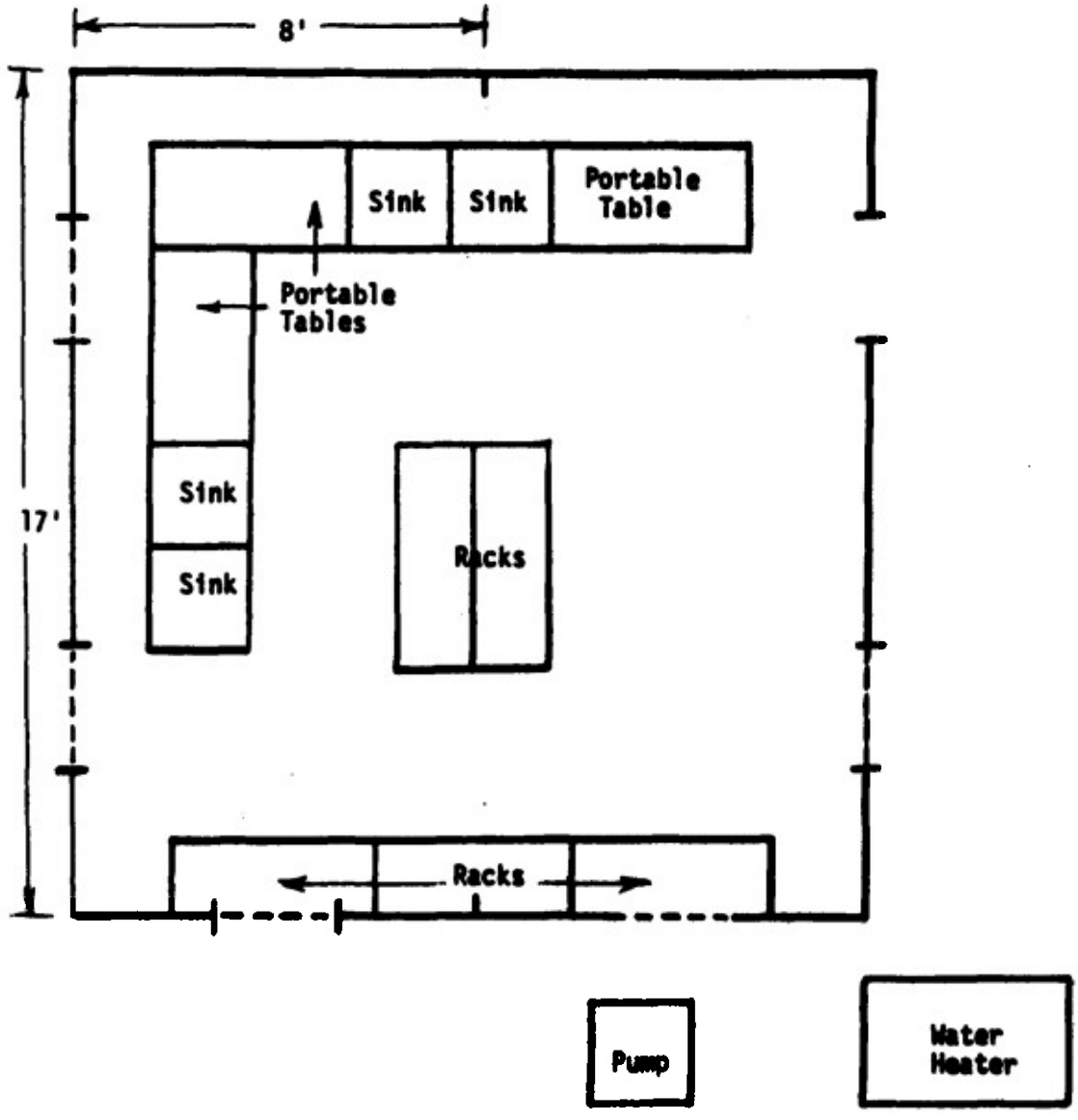


Figure A-7. Layout of Sanitation Center

APPENDIX B

CONSOLIDATION PLANS

CONSOLIDATION PLANS

The plan of consolidation for each type division; Infantry, Mechanized Infantry, and Armored Division is summarized in Tables B 1–3. An explanation of each column for these three tables is presented below:

HOST UNIT – The field kitchen (i.e., food service personnel and equipment) is assigned to and controlled by the host unit.

CUSTOMER UNITS – Units attached to a host unit for food service support.

STRENGTH – Total number of people being provided food service support by the host unit, includes all personnel assigned to the host unit or customer units (if any).

NO/DIVISION – Number of units per division.

The exact number of people assigned to each kitchen may vary somewhat due to continuous changes in unit TOE strength.

The actual number of combat battalions per division varies. For calculation purposes it was assumed that each division has nine combat battalions with the mix of combat battalions depending on the type of division.

TABLE B–1

Consolidation Plan: Infantry Division

Host Unit	Customer Units	Strength	No/ Division
HHC, DIVISION	– MP CO – DIV CP ELEMENT	412	1
AVN GS CO, AVN BN	– ALL BN UNITS – TAM CO, MT BN	598	1
CMD OP CO, SIG BN	– HHC, SIG BN – FWD COMM CO (–)	331	1
HHC, OISCOM	– SPT OP CO, SIG BN	311	1
HHC, ENG BN	– NONE	197	1
CBT ENG CO, ENG BN	– NONE	149	3
BRIDGE CO, ENG BN	– NONE	125	1
HHC, BDE	– FWD SIG CEN PLT. FWD COMM CO	160	3
HHT, AIR CAV SQDN	– ALL BN UNITS	963	1
HHB, DIV ARTY	– NONE	240	1
HHB, FA BN, 105T	– ALL BN UNITS	482	3
HHB, FA BN, 155T 8" SP	– ALL BN UNITS	816	1
AG CO	– FIN CO	375	1
HQ & LT MAINT CO	– HVY MAINT CO	384	1
FWO SPT CO, MAINT BN	– FWD SUP SEC, S&S CO – MED CO, MED BN	302	3
HHC, MED BN	– NONE	146	1
HHC, S&T BN (–)	– ALL BN UNITS	356	1
HHB, ADA BN	– NONE	99	1
ADA BTRY (VULCAN S.P.), AOA BN	– NONE	108	2
ADA BTRY (CHAPARREL S.P.), ADA BN	– NONE	122	2
HHC, INF BN	– ALL BN UNITS	797	7
HHC, INF BN (MECH)	– ALL BN UNITS	878	1
HHC, TANK BN	– ALL BN UNITS	553	1

TABLE B–2

Consolidation Plan: Infantry Division (Mechanized)

Host Unit	Customer Units	Strength	No/ Division
HHC, DIVISION	– MP CO – DIV CP ELEMENT	412	1
TAM CO, MAINT BN	– DIV AVN CO	213	1
CMD OP CO, SIG BN	– HHC, SIG BN – FWD COM CO (–)	331	1
HHC, DISCOM	– SUPT OP CO, SIG BN	311	1
HHC, ENG BN	– NONE	209	1
ENG CO, ENG BN	– NONE	155	4
BRIDGE CO, ENG BN	– NONE	172	1
HHC, BDE	– FWD SIG CEN PLT, FWD COMM CO	160	3
HHT, ARM CAV SQDN	– ALL CAV TRPS LESS AIR CAV TRP	670	1
AIR CAV TROOP	– NONE	206	1
HHB, DIV ARTY	– NONE	227	1
HHB, FA BN, 155	– ALL BN UNITS	539	3
HHB, FA BN, 8" SP	– ALL BN UNITS	515	1
AG CO	– FIN CO	375	1
HQ&LT MAINT CO	– HVY MAINT CO	384	1
FWD SPT CO, MAINT BN	– FWD SUP SEC S&S CO – MED CO, MED BN	302	3
HHC, MED BN	– NONE	146	1
HHC, S&T BN (–)	– ALL BN UNITS	379	1
HHB, ADA BN	– NONE	99	1
ADA BTRY (VULCAN, SP), ADA BN	– NONE	108	2
ADA BTRY (CHAPARREL, S.P.), ADA BN	– NONE	122	2
HHC, INF BN	– ALL BN UNITS	878	5
HHC, TANK BN	– ALL BN UNITS	553	4

TABLE B–3

Consolidation Plan: Tank Division

Host Unit	Customer Units	Strength	No/ Division
HHC, DIVISION	– MP CO – DIV CP ELEMENT	412	1
TAM CO, MAINT BN	– DIV AVN CO	213	1
CMO OP CO, SIG BN	– HHC, SIG BN – FWD COM CO (–)	331	1
HHC, DISCOM	– SUPT OP CO, SIG BN	311	1
HHC, ENG BN	– NONE	210	1
ENG CO, ENG BN	– NONE	154	4
BRIDGE CO, ENG BN	– NONE	151	1
HHC, BDE	– FWD SIG CEN PLT, FWD COMM CO	160	3
HHT, ARM CAV SQDN	– ALL CAV TRPS LESS AIR CAV TRP	670	1
AIR CAV TROOP	– NONE	206	1
HHB, DIV ARTY	– NONE	240	1
HHB, FA BN, 155	– ALL BN UNITS	539	3
HHB, FA BN, 8" SP	– ALL BN UNITS	515	1
AG CO	– FIN CO	375	1
HQ & LT MAINT CO	– HVY MNT CO	384	1
FWO SPT CO, MAINT BN	– FWD SUPPLY SEC, S&S CO – MED CO, MEO BN	302	3
HHC, MEO BN	– NONE	146	1
HHC, S & T BN (–)	– ALL BN UNITS	386	1
HHB, AOA BN	– NONE	124	1
ADA BTRY (VULCAN S.P.)	– NONE	108	2
ADA BTRY (CHAPARREL S.P.)	– NONE	121	2
TANK BN	– ALL BN UNITS	563	5
INF BN (MECH)	– ALL BN UNITS	878	4

APPENDIX C

LABOR COSTS

TABLE C–1

Total Uniform Annual Labor Costs
13 Division Force

Present System

Grade	No.	Cost	Total
CPT	13	$24,975	$ 324,875
LT	13	20,990	272,870
WO	85	21,463	1,395,095
E8	13	20,259	263,367
E7	1374	18,069	24,826,806
E6	1324	15,899	21,050,276
E5	2610	14,035	36,631,350
E4	1950	12,676	24,718,200
TOTAL	7362		$109,482,639
KP (E2)	5357	$11,111	59,521,827
SYSTEM PERSONNEL COST			$169,004,266

TABLE C--2

Total Uniform Annual Labor Costs
13 Division Force

Alternatives I and II

Grade	No.	Cost	Total
CPT	13	$24,975	$ 324,675
LT	13	20,990	272,870
WO	65	21,463	1,395,095
E8	201	20,259	4,072,059
E7	534	18,069	9,648,846
E6	521	15,899	8,283,379
E5	1951	14,035	27,382,285
E4	1669	12,676	21,156,244
TOTAL	4967		72,535,453
KP (E2)	4563	$11,111	50,699,493
SYSTEM PERSONNEL COST			$123,234,946

TABLE C–3

Total Uniform Annual Labor Costs
13 Division Force

Alternatives III and IV

Grade	No.	Cost	Total
CPT	13	$24,975	$ 324,675
LT	13	20,990	272,870
WO	65	21,463	1,395,095
E8	201	20,259	4,072,059
E7	534	18,069	9,648,846
E6	521	15,899	8,283,379
E5	1672	14,035	23,466,520
E4	1385	12,676	17,556,260
TOTAL	4404		$ 65,019,704
KP (E2)	3195	$11,111	$ 35,499,645
SYSTEM PERSONNEL COST			$100,519,349

DERIVATION OF ANNUAL LABOR COSTS

Enlisted Food Service Workars

Pay and Allowances by Grade

These costs are obtained from the FY 77 Presidant's Budget and includa annual basic pay, BAQ and BAS.

Grada	Pay
E–9	$1B,092
E–B	15,136
E–7	12,946
E–6	10,776
E–5	8,904
E–4	7,545
E–3	6,717
E–2	6,317
E–1	5,652
Average	
E–1 – E–3	6,258
E–4 – E–9	9,355
E–1 – E–9	B,1B9

Support Costs

Total OMA Army-wide variable support costs amounts to $3805 per military manyear.

Training Costs

Trai·ing costs are incurred only once for each phase of training and therefore are adjusted co a uniform annual cost. Figures used in this section are obtained from the February 1975, US Army NARADCOM Technical Report, 75–83 OR/SA, "A System Evaluation of Consolidated Field Feeding for the Army." These cost figures are then inflated to FY 77 dollar figures. For the enlisted food service personnel, the analysis is modeled on three grades, E–2, E–4 (to represent E–3, E–4, E–5) and E–7 (to represent E–6, E–7, E–B). BCT training costs are $2059, BCT and AIT training costs are $2697 and, 94B40 training costs are $5924.

The following assumptions ara made for the training costs for E–2 Kitchen Attendants:

1. 33% leave after one enlistment (4 years)

2. 33% stay for a career (20 years)

3. The remaining individuals average 12 years of service

$$\text{E-2 Training Costs} = .33\,(\$2059)\underset{(n=4)}{(CR\ )}(i=10) + (.33)\,(\$2059)\underset{(n=20)}{(CR\ )}(i=10) + (.34)(\$2059)\underset{(n=12)}{(CR\ )}(i=10)$$

$$= \$214 + \$80 + \$102$$
$$= \$396$$

The following assumptions are made for the E–4 model:

1. 66% that enlist leave after 4 years (per TSA, Ft. Lee, VA).

2. Of the 34% that remain 60% stay for a career, i.e., 20 years (per TSA, Ft. Lee, VA).

3. Those who remain for more than four but do not stay for a career average 12 years of service.

4. An E–4 has served an average of 3 years. Uniform annual training costs for an E–4 are expressed by the following equation:

$$\text{E–4 Training Costs} = .66(\$2697)\underset{(n=4)}{(CR\ )}(i=10) + (.34)(.6)(2697)\underset{(n=20)}{(CR\ )}(i=10) +$$

$$(.34)(.4)(2697)\underset{(n=12)}{(CR\ )}(i=10)$$

$$= \$562 + \$61 + 54$$
$$= \$677$$

The following assumptions are made for an E–7:

1. 80% stay for a career (20 years).

2. The 20% that don't remain for a career average 12 years of service.

3. Training for 94B40 occurs in the fifth year.

$$\text{E–7 Training Costs} = .80(\$2697)\,(CR\ )(i=10)(n=20) + .80\,(\$5924)\,(CR\ )(i=10)(n=20)(SPPW)(i=10)(n=5) +$$

$$.20(\$2697)\,(CR\ )(i=10)(n=12) + .20\,(\$5924)\,(CR\ )(i=10)(n=12)(SPPW)(i=10)(n=5)$$

$$= \$253 + \$346 + \$79 + \$108 = \$786$$

Rotation Costs

It is assumed that the average duty assignment is for a duration of 2 years and that 90% of the assignments are within CONUS. The uniform annual rotation costs are calculated based on a cost of $615 for a CONUS rotation and $1747 for a overseas rotation for enlisted personnel. The annual rotation costs are calculated as follows:

$$\text{Rotation Costs} = [.90(\$615) + .10\,(\$1747)]\,(CR\ )(i=10)(n=2)$$

$$= \$420$$

Initial Clothing and Accession Costs

Initial clothing and accession travel for enlisted personnel is $906. The formulas used for the uniform annual costs for this area are the same as for training costs. Thus:

E–2 Model = $173
E–4 Model = $229
E–7 Model = $112

Summary

The total uniform annual costs for enlisted personnel incurred for each pay grade for food service personnel is summarized as follows:

	E–2	E–3	E–4	E–5	E–6	E–7	E–8
Salary & Benefits	$ 6,317	$ 6,717	$ 7,545	$ 8,904	$10,776	$12,946	$15,136
Support Costs	3,805	3,805	3,805	3,805	3,805	3,805	3,805
Training Costs	396	677	677	677	786	786	786
Rotation Costs	420	420	420	420	420	420	420
Initial Clothing & Accession Costs	173	229	229	229	112	112	112
Total Uniform Annual Cost	$11,111	$11,848	$12,676	$14,035	$15,899	$18,069	$20,259

Food Service Officers

Pay and Allowance by Grade

Composite rates from the FY 77 President's Budget are:

Commissioned Officer

Grade	Pay
O–10	$40,337
O–9	39,994
O–8	40,430
O–7	35,720
O–6	31,004
O–5	25,819
O–4	21,343
O–3	18,192
O–2	14,207
O–1	10,327

Warrant Officer

Grade	Pay
W–4	$20,630
W–3	17,175
W–2	13,869
W–1	13,012
Average	
W–1 – W–4	15,173

Support Costs

Support costs for officers are the same as for enlisted personnel, $3805.

Training Costs

Training costs for MOS 4130 are $8560[3]. The following assumptions are made:

1. Warrant Officers avarage 20 years of service.

2. 0–4's average 15 years of service.

3. 0–2's, 0–3's average 10 years of service.

Uniform annual training costs are then:

$$\text{0–2's, 0–3's} = \$8560 \begin{matrix}(CR\ ) \\ (i=10) \\ (n=10)\end{matrix}$$

$$= \$1393$$

$$\text{0–4's} = \$8560 \begin{matrix}(CR\ ) \\ (i=10) \\ (n=15)\end{matrix}$$

$$= \$1125$$

$$\text{Warrant Officers} = \$8560 \begin{matrix}(CR\ ) \\ (i=10) \\ (n=20)\end{matrix}$$

$$= \$1005$$

Rotation Costs

Actual rotation costs for officers are $2754 for intra-CONUS rotations and $5270 for CONUS to overseas. Average tour of duty is assumed to be 3 years. The Uniform annual rotation costs are then given by tha following equation:

$$\text{Rotation Costs} = [.90\ (\$2754) + .10\ (\$5270)\ ] \begin{matrix}(CR\ ) \\ (i=10) \\ (n=3)\end{matrix}$$

$$= \$1209$$

Initial Clothing and Accession Costs

Actual cost for an officer is $2309. Annual cost representations are:

0–2's, 0–3's = $376

0–4's, = $304

Warrant Officer = $271

Summary

The total uniform annual costs for Food Service Officers are:

	0–2	0-3	0–4	Average Warrant Officer
Salaries & Benefits	$14,207	$18,192	$21,343	$15,173
Support Costs	3,805	3,805	3,805	3,805
Training Costs	1,393	1,393	1,125	1,005
Rotation Costs	1,209	1,209	1,209	1,209
Initial Clothing & Accession Costs	376	376	304	271
Total Uniform Annual Costs	$20,990	$24,975	$27,786	$21,463

APPENDIX D

EQUIPMENT COSTS

TABLE D–1

Uniform Annual Cost for Equipment for the Present System

	A (Unit Cost)	B Total No. Required	C (Total Cost)	D (Economic Life)	Uniform Annual Cost (C ÷ D)
Accessory Outfit	$ 83	1,365	$ 113,295	3	$ 37,765
Insulated Food Container	71	6,196	581,916	2	290,958
Immersion Heater	92	10,920	1,004,640	4	251,160
Field Range	772	4,095	3,161,340	4	790,335
M–48 Tent	812	1,365	1,108,380	1	1,108,380
Water Trailer	1,920	1,365	2,620,800	6	436,800
Cargo Trailer	1,049	1,365	1,431,885	6	238,648
2–1/2 Ton Truck	9,380	1,365	12,803,700	6	2,133,950
Refrigeration Equipment*					518,284
					$5,806,280

*Annual refrigeration equipment costs are calculated as follows:

Refrigeration Equipment Per Division

	Quantity	Unit Cost	Total Cost	Economic Life	Annual Cost
400 Cu. Ft. Reefers	2	$ 8,230	$ 16,460	12	$ 1,372
Refrigeration Units Mechanical Type	6	1,701	13,608	12	1,134
Semi Trailer Refrig.	19	7,986	151,734	12	12,644
Truck Tractors	10	14,831	148,310	6	24,716
Total (One Division)			$330,112		$39,868

$39,868/Division x 13 Divisions = $518,284 Annual Cost.

TABLE D–2

Uniform Annual Cost for Equipment for Alternative I (13 Division Force)

	No.	Cost Unit	Total Cost	Economic Life	Annual Cost
Under 250					
MKT	216	$10,952	$2,365,632	Variable	$ 746,286
Immersion Heaters	1753	92	161,276	4	40,319
2–1/2 Ton Truck	216	9,380	2,026,080	6	337,680
Water Trailer	216	1,920	414,720	6	69,120
TOTAL (UNDER 250)			$4,967,708		$1,193,405
251–500					
GP Medium Tents	270	$ 812	$ 219,240	1	$ 219,240
Range Outfits/Complete	644	772	497,168	4	124,292
Accessory Outfits	215	83	17,845	3	5,948
Immersion Heaters	2561	92	235,612	4	58,903
Food Container (Ins)	4478	71	317,938	2	158,969
2–1/2 Ton Truck	405	9,380	3,798,900	6	633,150
Water Trailer	135	1,920	259,200	6	43,200
Cargo Trailer	270	1,049	283,230	6	47,205
TOTAL (251–500)			$5,629,133		$1,290,907
501–1000					
GP Medium Tents	340	$ 812	$ 276,080	1	$ 276,080
Range Outfits/Complete	1771	772	1,367,212	4	341,803
Accessory Outfits	590	83	48,970	3	16,323
Immersion Heaters	7423	92	682,916	4	170,729
Food Container (Ins)	14,736	71	1,046,256	2	523,128
2–1/2 Ton Truck	680	9,380	6,378,400	6	1,063,067
Water Trailer	340	1,920	652,800	6	108,800
Cargo Trailer	340	1,049	356,660	6	59,443
TOTAL (501–1000)			$10,809,294		$2,559,373
Total Equipment Cost			$21,406,135		$5,043,685
+ Refrigeration Equipment					518,284
TOTAL ANNUAL COST					$5,561,969

TABLE D–3

Uniform Annual Cost for Equipment for Alternative II (13 Division Force)

	No.	Cost Unit	Total Cost	Annual Cost
Under 250				
Same as Alternative I			$4,967,708	$1,193,405
251–500				
MKT (Units of 2)	135	$23,608	$3,187,080	$1,190,565
Immersion Heaters	2561	92	235,612	58,903
2–1/2 Ton Truck	405	9,380	3,798,900	633,150
Water Trailer	135	1,920	259,200	43,200
TOTAL (251–500)			$7,480,792	$1,925,818
501–1000				
Same as Alternative I			$10,809,294	$2,559,373
Total Equipment Cost			$23,257,794	$5,678,596
+ Refrigeration Equipment				518,284
TOTAL ANNUAL COST				$6,196,880

TABLE D–4

Uniform Annual Cost for Equipment for Alternative III (13 Division Force)

	No.	Cost Unit	Total Cost	Annual Cost
Under 250				
Same as Alternative I			$4,967,708	$1,193,405
New Sanitation Center	216	$ 4,525	977,400	331,344
TOTAL (UNDER 250)			$5,945,108	$1,524,749
251–500				
XM–75A with New Sanitation Center	135	$35,076	$4,735,260	$1,719,765
2–1/2 Ton Truck	405	9,380	3,798,900	633,150
Water Trailer	135	1,920	259,200	43,200
Cargo Trailer	270	1,049	283,230	47,205
TOTAL (251–500)			$ 9,076,590	$2,443,320
501–1000				
XM–75 with New Sanitation Center	170	$43,305	$7,361,850	$2,596,410
2–1/2 Ton Truck	680	9,380	6,378,400	1,063,067
Water Trailer	340	1,920	652,800	108,800
Cargo Trailer	340	1,049	356,660	59,443
TOTAL (501–1000)			$14,749,710	$3,827,720
Total Equipment Cost			$29,771,408	$7,795,789
+ Refrigeration Equipment				518,284
TOTAL ANNUAL COST				$8,314,073

TABLE D–5

Uniform Annual Cost for Equipment for Alternative IV (13 Division Force)

	No.	Cost Unit	Total Cost	Annual Cost
Under 250				
Same as Alternative III			$5,945,108	$1,524,749
251–500				
2 MKT With New Sanitation Center	135	$34,753	$4,691,655	$1,533,465
2–1/2 Ton Truck	405	9,380	3,798,900	633,150
Water Trailer	135	1,920	259,200	43,200
TOTAL (251–500)			$ 8,749,755	$2,209,815
501–1000				
Same as Alternative III			$14,596,710	$3,827,720
Total Equipment Cost			$29,291,573	$7,562,284
+ Refrigeration Equipment				518,284
TOTAL ANNUAL COST				$8,080,568

TABLE D–6

2–1/2 Ton Trucks & Trailers (Cargo & Water) Requirements for Alternatives

	Size of Kitchen		
Alternative	99–250	251–500	501–1000
I	1 Truck 1 Water Trailer	3 Trucks 2 Cargo Trailers 1 Water Trailer	4 Trucks 2 Cargo Trailers 2 Water Trailers
II	1 Truck 1 Water Trailer	3 Trucks 1 Water Trailer	4 Trucks 2 Water Trailers 2 Cargo Trailers
III	1 Truck 1 Water Trailer	3 Trucks 1 Water Trailer 2 Cargo Trailers	4 Trucks 2 Water Trailers 2 Cargo Trailers
IV	1 Truck 1 Water Trailer	3 Trucks 1 Water Trailer	4 Trucks 2 Water Trailers 2 Cargo Trailers

TABLE D–7

Equipment Cost for MKT System with New Sanitation Center and Labor Saving Devices (Alternative IV)

Quantity	Item	Unit Cost	System Cost	Years Life	Annual Cost
2	New Equipment Government and Contractor Furnished Kitchen, Field, Trailer Mounted (MIL Spec MIL-K-43911 (GL))	$8,868	$17,736	Variable	$ 5,925
1	Pot Shack, Frame	1,091	1,091	8	204
	Fabric	869	869	2	501
	Fly	240	240	1	264
4	Sanitizing Sinks, Complete	550	2,200	8	412
4	Shelving	90	360	2	207
1	Hot Water Heater	3,500	3,500	8	656
1	Meat Slicer, Electric	500	500	8	94
1	Veg. Cutter, Electric	1,000	1,000	8	187
1	Can Opener, Electric	95	95	2	55
15	Jugs, Ins Bev Disp	50	750	1	825
	Total New Equipment		$28,341		$ 9,330
*4	Range Outfits, Complete	772	3,088	4	772
*12	Burner Units M–2A	135	1,620	4	406
*24	Food Containers, Ins.	71	1,704	2	852
	Total Conventional Equipment		$ 6,412		$ 2,029
	Total System Cost		$34,753		$11,359

*Items currently in system and obtainable from Conventional System.
It is assumed that the Government furnished range cabinets and burner units could be supplied from already existing stock.

TABLE D–8

Equipment Cost for XM–75 System with New Sanitation Center (Alternative III and IV)

Quantity	Item	Unit Cost	System Cost	Years Life	Annual Cost
1	Tent, Kitchen, Frame	$2,844	$ 2,844	8	$ 533
		2,300	2,300	2	1,325
		856	856	1	942
2	Pot Shack & Dry Storage, Frame	1,091	2,182	8	409
	Fabric	869	1,738	2	1,001
	Fly	240	480	1	528
4	Griddle & Food Warmer Components	1,800	7,200	8	1,349
	Griddle	400	1,600	1	1,760
10	Work Table Tops	50	500	4	158
	Legs	75	750	8	141
4	Sanitizing Sinks, Complete	550	2,200	8	412
4	Shelving	90	360	2	207
1	Hot Water Heater	3,500	3,500	8	656
1	Meat Slicer, Electric	500	500	8	94
1	Veg. Cutter, Electric	1,000	1,000	8	187
1	Opener Can, Electric	95	95	2	55
1	Serving Utensils	300	300	8	56
8	Pan B & R w/o Cover	56	448	4	112
20	Jugs, Ins. Bev Disp	50	1,000	1	1,100
	Total New Equipment		$29,853		$11,025
*10	Range Outfits Complete	772	7,720	4	1,930
*10	Burner Units, M–2A	135	1,350	4	338
* 4	Accessory Outfits	83	332	3	111
*50	Food Containers, Ins.	71	3,550	2	1,775
	Total Conventional Equipment		$12,952		$ 4,154
	Manuals and Operating Instructions		500		94
	Total System Cost		$43,305		$15,273

*Items currently in system and obtainable from Conventional System.

TABLE D–9

Equipment Cost for XM–75A System

Quantity	Item	Unit Cost	System Cost	Years Life	Annual Cost
1	Tent, Kitchen, Frame	$2,275	$2,275	8	426
	Fabric	1,840	1,840	2	1,060
	Fly	685	685	1	754
2	Pot Shack & Dry Storage, Frame	1,091	2,182	8	409
	Fabric	869	1,738	2	1,001
	Fly	240	480	1	528
2	Griddle & Food Warmer Components	1,800	3,600	8	675
	Griddle	400	800	1	880
6	Work Table Top	50	300	4	95
	Legs	75	450	8	84
4	Sanitizing Sinks, Complete	550	2,200	8	412
4	Shelving	90	360	2	207
1	Hot Water Heater	3,500	3,500	8	656
1	Meat Slicer, Electric	500	500	8	94
1	Veg. Cutter, Electric	1,000	1,000	8	187
1	Opener Can, Electric	95	95	2	55
1	Serving Utensils	300	300	8	56
6	Pan B&R w/o Cover	56	336	4	84
15	Jugs, Ins. Bev Disp	50	750	1	825
	Total New Equipment		$23,391		$8,488
*8	Range Outfits/Complete	772	6,176	4	1,544
*8	Burner Units, M–2A	135	1,080	4	270
*3	Accessory Outfits	83	249	3	83
*40	Food Containers, Ins.	71	2,840	2	1,420
*4	Tableware, Field	210	840	1	840
	Total Conventional Equipment		$11,185		$4,157
	Manuals and Operating Instructions		500		94
	Total System Cost		$35,076		$12,739

*Items currently in system and obtainable from Conventional System.

APPENDIX E

DETAILED COST DERIVATIONS

DETAILED COST DERIVATIONS

Food Costs

Food costs ara calculated on a total strength for the thirteen AIM Divisions of 199,200 men and ara based on the following combination of menus and costs:

Type of Menu	% Total	Cost/Ration	Weighted Costs
28 Day Viet Nam ("A")	70.58	$2.45	$1.73
10 Day Standard "B"	6.42	2.20	.14
Operational Rations (MCI)	23.00	3.94	.91
Total			$2.78

These percentages taka into account that 23% of all rations will be operational. In addition, during tha initial month of the operation those meals which are not MCI's will be "B" rations. Food costs are averages over the entire menu cycles and are based on 1 July 1976 food costs.

Total annual food costs for tha present system is:

$2.78 x 365 days/years x 199,200 = $202,128,240.

Alternatives I and II save 3,189 kitchen personnel. Total annual food cost for these systems is:

$2.78 x 365 days/year x 196,011 = $198,892,362.

Alternatives III and IV save 5,120 kitchen personnel. Total annual food cost for these systems is:

$2.78 x 365 x 194,080 = $196,932,976.

Labor Costs

The total uniform annual lebor costs for the present end alternativa systems are shown in Tables C–1, C-2, and C–3.

Kitchen Equipment Costs

Detailed annual kitchen equipment cost for the present and alternativa systems ere exhibited in Tables D–1 through D–5.

Disposable Costs

All alternative systems employ the same mix of disposables. At the kitchen site, stainless steel trays, and disposable utensils and cups are used. Remote sites will use disposable trays, utensils, and cups. The assumption shall be made that 50% of the meals are served at the kitchen site and 50% in the field. The costs of the items are based on GSA prices and are as follows:

Stainless Steel Mess Tray	$3.55/each
Disposable Tray	.0330/each
Utensils	.0425/set
Cup	.0091/each

Alternatives I and II

196,011 men x 3 meals x 365 days/years x .77 (operational ration factor)

= 165,266,675 hot meals.

Site Cost 82,633,337 x $.0607	=	$5,015,844/year
+ Stainless Steel Trays		347,920
Remote Cost 82,633,337 x $.0937	=	7,742,744
Total Annual Costs		$13,106,508

Alternatives III and IV

194,080 men x 3 meals x 365 days/years x .77 (operational ration factor)

= 163,638,552 hot meals.

Site Cost 81,819,276 x $.0607	=	$4,966,430
+ Stainless Steel Trays		344,492
Remote Cost 81,819,276 x $.0937	=	7,666,466
Total Annual Costs		$12,977,388

Transportation Costs — Food

Transportation costs for food are $.367 per ration from the United States to the brigade trains which are assumed to be 75 miles from the rear depot. This weighted cost factor reflects the assumed proportions of "A", and "B", and operational rations stated previously. Total annual costs to transport food for each system are:

Present System

$.367 x 365 days x 199,200 men = $26,683,836

Alternatives I and II

$.367 x 365 days x 196,011 men = $26,256,653

Alternatives III and IV

$.367 x 365 days x 194,080 men = $25,997,986

Transportation Costs — Disposables

Annual costs for transportation of disposables are based on the cube of the items. Transportation costs are calculated from the United States to brigade trains.

Present System

No Disposables.

Alternatives I and II

Trays and Utensils to Rear Depot (165,266,675 sets)	$1,558,796
Trays and Utensils Within Theater	74,397
Annual Cost	$1,633,193

Alternatives III and IV

Trays and Utensils to Rear Depot (163,638,552 sets)	$1,543,439
Trays and Utensils Within Theater	73,637
Annual Cost	$1,617,076

Water Costs

Water costs for the baseline system are computed based on an average kitchen size of 145 men, and are comprised of the following elements:

	Gallons/Kitchen/Day
Drinking & Personal Hygiene 145 x 3 gallons/day	435
Messkit Sanitation 2 lines x 80 gallons/line/day x 2 meals/day	320
Cooking 145 men x .46 gallons/man/day	67
Pots and Utensils Sanitation 2 immersion heaters x 75 gallons/meal x 2 meals/day	300
Total Per Kitchen	1122

Water cost is $.005 per gallon based on labor costs of water supply units. Annual water costs are then:

1122 gallons/kitchen/day x 105 kitchens/division x 13 divisions

x 365 days x $.005/gallon = $2,795,042.

Annual Water Cost

Alternatives I and II

843,094 gallons/day x 365 days x $.005/gallon $1,538,647

Alternatives III and IV

830,032 gallons/day x 365 days x $.005/gallon $1,514,808

Water costs for the alternative systems are calculated as follows:

Usage Item	Gallons/Day
Drinking & Personal Hygiene 199,200 men x 3 gal/day/man	597,600
Cooking 199,200 men x .46 gal/man/dey	91,632
Pots and Utensils Sanitation Under 250 (Immersion Heaters) 216 kitchens x 150 gallons/meel x 2 meal/day	64,800
250–500 (Immersion Heaters) 135 kitchens x 187.5 gallons/dey	25,312
Over 500 (Immersion Heaters)[32] 170 kitchens x 375 gallons/day	63,750
250–500 (Hot Water Heaters)[33] 135 kitchens x 160 gallons/dey	21,600
Over 500 (Hot Water Heeters) 170 kitchens x 320 gallons/day	54,400

Electrical Power Cost

Alternatives III and IV when serving assigned strengths greater than 250 customers require additional power. One 10 KW generator would be required per kitchen site. The cost per elternative would be:

305 generators x $2,385/generator (6 yr. cr life) = $121,238/year

Augmented Labor Force

The elternative systems will require support from the troops in the field when feeding at remote sites. This support will consist of two men for 1.5 hour per meal for "A" and "B" rations. The lebor will be approximately .25 men year for kitchens supporting over 250 individuels.

.25 man year x 650 sites x $8,904/E–5 salary = $1,446,900

[32]Op. cit. 4.

[33]Op. cit. 3.

Inventory Storage Costs for Disposables

1. Assume a requirement for a 90 day inventory supply on hand.

2. Dry storage costs are:[34]

Disposables with tray	$.000361/month/meal
Utensils	.000135/month/meal
Handling with tray	.000507/meal
Handling utensils	.000190/meal

3. Cost are calculated as follows:

Each system with disposables requires 20,000,000 disposables with tray
20,000,000 utensils

With tray = (20,000,000 x $.000361 x 12) + ($.001014) x 20,000,000
= ($86,640 + $20,280)
= $106,920

Utensils = (20,000,000 x .000135 x 12) + ($.000380) x 20,000,000
= $32,400 + 7,600
= $40,000

TOTAL COST OF DISPOSABLES = $146,920/YEAR

[34] Yawitz, Aubrey A., Technical Memorandum No. 76--1, Commercial Holding Cost Differential Between Dry Storage and Controlled Cold Storage for Meal Combat, Individual (MCI), US Army Troop Support Command, October 1976.

TABLE E–1

Annual Fuel Costs for 13 AIM Divisions

Equipment	Present System		Alternative I		Alternative II		Alternative III & IV	
	Units	Gallons	Units	Gallons	Units	Gallons	Units	Gallons
Sanitation								
Immersion Heaters .428 gal/hr x 12 hr/day	13,442	69,038	11,737	60,281	11,737	60,281	1,753	9,003
Hot Water Heater (10 gal/day)							315	3,150
Cooking								
M–2A Burners .5 gal/hr x 12 hr/day	4,150	24,900	3,711	22,266	4,687	28,122	6,466	38,796
Refrigeration								
288 gal/division	13	3,744	13	3,744	13	3,744	13	3,744
Trucks								
100 miles/day x 5 miles/gal	1,365	27,300	521	10,420	521	10,420	521	10,420
TOTAL		124,982		96,711		102,567		65,113
x 365 days/year		45,618,430		35,299,515		37,436,955		23,766,245
x .77 Operational Ration Factor		35,126,191		27,180,627		28,826,456		18,300,009
x $.44/gal								
TOTAL ANNUAL FUEL COST		$ 15,455,524		$ 11,959,476		$ 12,683,640		$ 8,052,004